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The Journal

OF THE

AMERICAN DENTAL ASSOCIATION

Abutments—*Nelson and Hinds*

Dental Health Program—*Knutson*

Mottled Teeth—*Smith and McInnes*

Gold Foil Filling—*Green and Simon*

Time for Orthodontic Treatment—*Hellman*

Rapid Treatment in Malocclusion—*Anderson*

Dimensional Change in Amalgams—*Jarabak*

Acrylics in Restorative Dentistry—*Tylman*

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ORAL ASPECTS OF DIABETES MELLITUS

By ABRAHAM RUDY, M.D., and M. MICHAEL COHEN, D.M.D., Boston, Mass.

IN 1938, we reported a study of the oral manifestations in 403 diabetic patients treated at the Beth Israel Hospital. In a continued follow up study of this group and a number of additional cases, we have made further observations of interest, which we are presenting in this paper.

Our total at present consists of 581 cases, 219 of them edentulous. Thirteen of the patients were children of 18, and five were young adults, up to the age of 30. Several in this group of patients have been seen four times annually. The accompanying table gives the findings in detail in this selected group. The oral hygiene was poor only in four cases, and was accompanied by a mild gingivitis. Six patients had a high caries index and the remainder had a moderate to low incidence of caries. Repeated roentgenographic examinations revealed no changes in the supporting bone around the teeth even in the severe and poorly controlled cases of diabetes. Case 2, in the accompanying table, is that of a 14-year-old girl with severe and poorly controlled diabetes of two years' duration, but showing excellent dentition and normal bone. (Fig. 1.) There was a marked change in the bone of the lower incisor and a gingivitis in the same region five years later.

Case 13, which was reported previously to have had a severe periodontosis (diffuse alveolar atrophy), showed continued progression of the condition until all the teeth were either exfoliated or extracted. Careful roentgenographic as well as microscopic studies of the supporting bone have been carried out and will be reported elsewhere in detail. The patient in Case 14, who is the older brother, and who had had severe fairly well-controlled diabetes for eighteen years, shows an excellent parodontal structure.

In the adult medically controlled diabetic patients, further clinical and roentgenographic observations have confirmed our previous impression that this group has a high incidence of the marginal type of periodontitis due to calcular deposits and lack of oral hygiene. Contrary to our previous belief, we find that periodontosis occurs infrequently in adult diabetic patients.

Only three of our patients showed

From the Diabetic and Dental Clinics of the Beth Israel Hospital.

Aided by a grant from the Charlton Research Fund, Tufts College Medical School.

FINDINGS IN SELECTED GROUP

No.	Patient	Sex	Age at Onset of Diabetes	Present Age	Duration of Diabetes Years	Units of Insulin	Control of Diabetes	Condition of Mouth *			Remarks
								Gums	Teeth	Supporting Bone	
1	R.D.	♂	8	12½	4½	40	Fair	S	L	N	Lack of oral hygiene; malocclusion Class II
2	M.L.	♀	12	19	7	72	Fair	N	L	A	Diabetic coma several times; control fair for past two years
3	B.S.	♂	18	23	5	72	Poor	S	H	N	Diabetic coma on several occasions; poor oral hygiene
4	J.C.	♂	12	21	9	48	Fair	N	H	N	
5	D.P.	♀	15	27	12	40	Poor	N	H	N	Coma on one occasion
6	L.S.	♀	12	19	7	32	Poor	N	H	N	Malocclusion; open bite
7	M.G.	♀	12	13	1	32	Fair	S	A	N	Poor hygiene; malocclusion Class II
8	G.S.	♀	1¼	1½	⅙	16	Fair	—	—	—	—
9	M.A.	♀	13	16	3	40	Fair	N	A	N	Upper left lateral incisor congenitally missing; lack of oral hygiene
10	J.S.	♀	6½	8	1¾	30	Fair	N	L	N	
11	J.L.	♂	6	15	9	28	Fair	N	A	N	Slight cheilosis
12	W.F.	♂	26	31	5	76	Poor	S	H	N	Multiple abscesses due to lack of dental care; chronic osteomyelitis
13	M.E.	♂	13	24	11	80	Poor	S	H	P	All teeth extracted or exfoliated owing to severe periodontosis
14	S.E.	♂	13	31	18	40	Fair	N	A	N	Brother of patient 13
15	E.P.	♂	25	26	1	50	Good	N	H	N	Cheilosis
16	R.C.	♀	11	13	2	26	Fair	N	L	N	
17	E.P.	♀	24	26	2	84	Fair	S	A	N	Malocclusion; poor oral hygiene
18	S.P.	♂	19	19		20	Good	S	H	N	Tendency to cervical decay throughout mouth

*Normal, N; spongy, S; atrophy, A; low caries index, L; average caries index, A; high caries index, H; periodontosis, P.

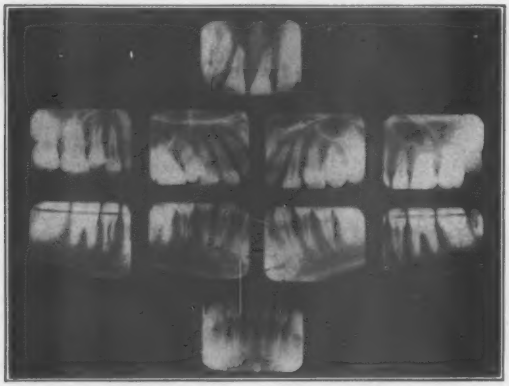

Fig. 1.—Excellent condition of dentition and paradentium in 14-year-old girl with severe and poorly controlled diabetes of two years' duration.

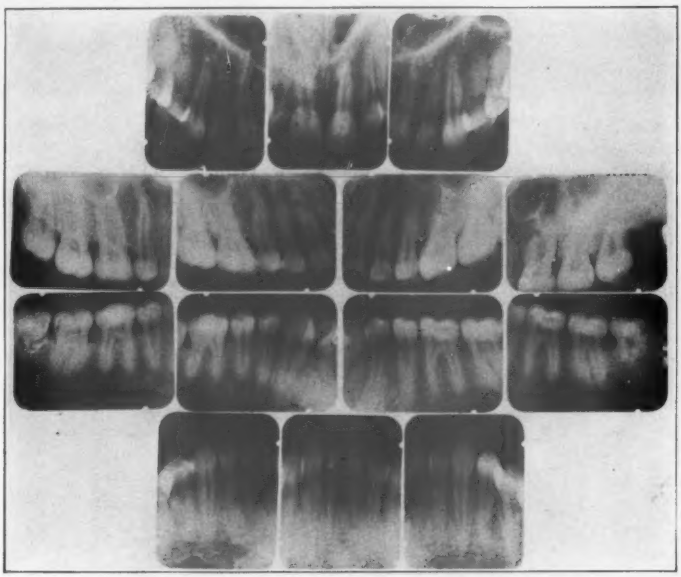

Fig. 2.—Case shown in Figure 1, five years later; atrophy of bone in lower incisor region.

advanced periodontosis. We are reporting only two, since, in the third case, we were unable to obtain a bone biopsy. The histopathologic condition of their bone is similar to that found in Case 13; namely, fibrosis of the marrow spaces by osteoclastic activity.

REPORT OF CASES

CASE 1.—*Diabetes mellitus, moderately severe; progressive periodontosis.*—C. G., a woman, aged 54, had been known to have diabetes mellitus since 1929. At the time of discovery, the condition was mild and easily controlled by diet. The patient, however, did not adhere to the diet. In December

*Normal, N; spongy, S; atrophy, A; low caries index, L; average caries index, A; high caries index, H; periodontosis, P.

1935, it was necessary to prescribe insulin. At about the same time, the patient was seen in the dental clinic, where examination of her mouth revealed dental caries. The gingivae were not inflamed. Roentgenograms of the teeth revealed a definite resorption of supporting bone. Since 1935, the diabetes had continued to grow worse, and about 40 units of insulin has been required daily on a moderately high carbohydrate diet. Repeated roentgenograms of the teeth revealed marked progression of the bone atrophy.

In 1939, a parodontal abscess developed in the upper left first permanent molar, which had to be extracted. In 1940, there was definite loosening and pathologic wandering of the maxillary incisor teeth. At this time, the upper right bicuspids were removed and a bone biopsy was made. The latter showed fibrosis of the marrow spaces by osteoclastic activity. (Figs. 4, 5 and 6.)

In this case, the development of the periodontosis ran parallel with the progression of the diabetes. The etiology of the periodontosis is still undetermined.

Fig. 3.—Case shown in Figure 1, five years later; gingival inflammation in lower incisor region.

Fig. 4.—Pathologic wandering of teeth in woman aged 54 with diabetes of eleven years' duration.

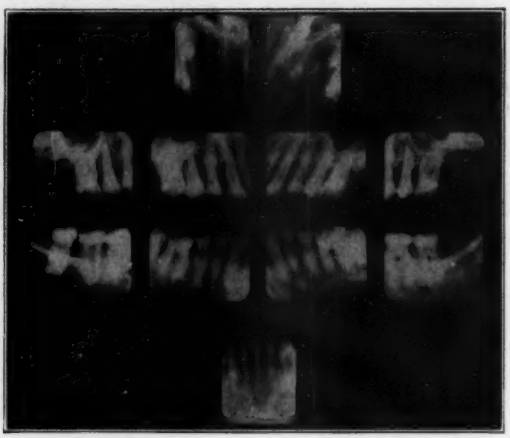

Fig. 5.—Case shown in Figure 4; atrophy of bone throughout mouth.

CASE 2.—*Diabetes mellitus, mild; progressive periodontosis.*—L. E., a woman, aged 51, had diabetes mellitus, which was discovered

in 1932. At that time, it was easily controlled by diet. The patient was not seen for seven years, when she returned to the clinic in 1939, showing considerable sugar in the urine. At the same time, she complained of painful gingivae and loosening of the teeth. She could not wear her artificial denture because of pain in the gums. The mouth showed marked gingival infection and loosening and wandering of the teeth. Roentgenograms revealed marked periodontosis. On small doses of insulin, the diabetes was fairly well controlled. The patient continued, however, to complain of pain in the gums, preventing adequate mastication.

In March 1940, it was suspected that the condition of the gums might have been due to a deficiency in one of the components of vitamin B complex; namely, riboflavin (B_2). The patient was therefore given riboflavin orally without any local treatment. The inflammation of the gums, as well as the tenderness, cleared up in about one week. Two weeks later, it was possible for her to wear her denture, although the teeth continued to be loose. In May 1940, the maxillary teeth were removed, and, at the same time, the riboflavin was discontinued. In January 1941, the patient had influenza for several weeks. Thereafter, she again developed in-

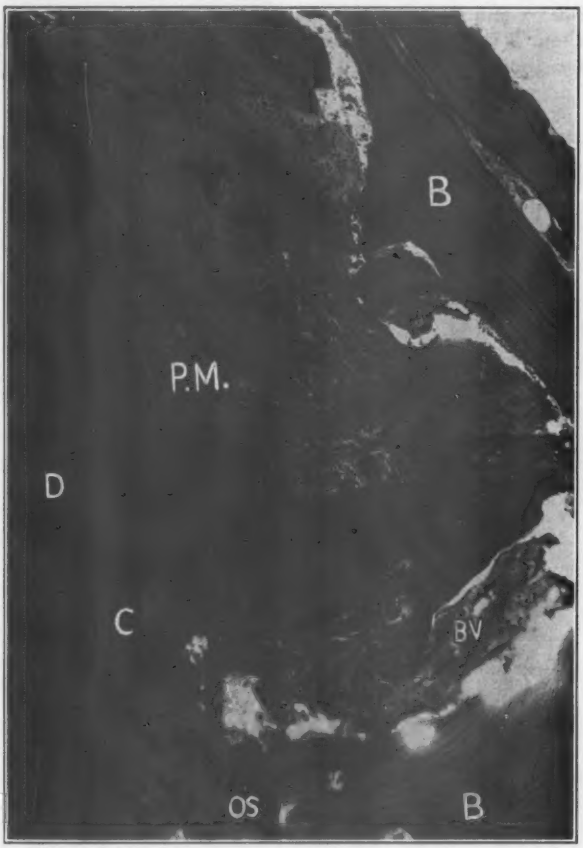

Fig. 6.—Cross-section of bone of case in Figures 4-5. D, dentin; C, cementum; PM, peridental membrane; B, bone; BV, blood vessel; OS, osteoclasts. Osteoclastic resorption and replacement of bone by connective tissue are taking place.

flammation of the gums, which responded quickly to a high vitamin B concentrate. Several bone biopsies made during the extractions showed fibrosis of the marrow spaces by osteoclastic activity. (Figs. 7, 8 and 9.)

In this case, a severe periodontosis developed in spite of the fact that the diabetes was fairly mild. The response of the soft tissue inflammation to riboflavin and vitamin B complex in the absence of local treatment on two different occasions is of interest.

The acute manifestations in the mouths of diabetic patients as described in our previous paper usually occur dur-

Fig. 7.—Pathologic wandering of teeth in woman aged 51 with diabetes of eight years' duration.

ing the acute stage of the diabetes. They consist of inflamed gingival papillae, which are tender and bleed profusely on the slightest pressure, and of polypoid tissue, which exudes from under the free margin of the gingivae. At times, there is also a burning sensation in the mouth and tongue. The mouth symptoms usually subside with control of the diabetes, either by diet alone or with insulin, without vitamins.

At times, a diabetic will complain of dryness and a burning sensation in the mouth and tongue or of pain in the gums, even when edentulous. The tongue in these patients sometimes is beefy, smooth or pebbled, and there may be a cheilosis—fissures in the angle of the mouth—as well as dryness and cracking of the lips. Ulceration of the mucosa of the mouth is not unusual. These manifestations can be found in a so-called controlled diabetic; that is, in the absence of glycosuria and of hyperglycemia. They are now considered as a sign of deficiency of the various components of the vitamin B complex. A careful search in the rest of the body frequently reveals other signs of the deficiency.

Whether the above-described acute inflammatory changes in the mouth are the result of a vitamin deficiency is still a matter of speculation. Not unlike pruritus vulvae, it occurs usually in the acute stages of diabetes and frequently subsides with control of the disease. On the other hand, the manifestations in the mouth, just as the pruritus vulvae, may improve with vitamin therapy at the time the glycosuria is still present.

The following cases have been chosen to illustrate the relation of the mouth manifestations in diabetes to deficiency states.

CASE 3.—*Diabetes mellitus, moderately severe; pain in the teeth.*—I. P., a woman, aged 70, had a diabetes mellitus, first discovered in 1938 and fairly well controlled with diet and insulin. In 1939, the patient complained of pain in the teeth. Since roentgenograms did not reveal any pathologic condition, a diagnosis of neuritis of the mandibular branch of the trigeminal nerve was made. With the administration of thiamine chloride (vitamin B_1) and vitamin B complex, the pain subsided in a few weeks.

In this case, a neuritis was the cause of referred pain in the teeth. This condition should therefore be considered before resorting to extraction.

CASE 4.—*Diabetes mellitus, mild; pellagra; extensive ulceration of the mouth and tongue.*—I. B., a woman, aged 68, had a diabetes mellitus, discovered in 1932, since

which time she had suffered from a recurrent infection of the foot requiring ten admissions to the hospital. There was a considerable loss of weight; also a gradual development of generalized edema of undertermined origin, with hypoproteinemia and hypercholesteremia. There was also a neurogenic condition of the bladder, with transitory urinary retention. On the last admission, in 1935, the diabetes was easily controlled by diet and very small doses of insulin. A swelling of the lower jaw developed with some sloughing of the right cheek. Roentgenograms revealed an abscess of the inferior right second molar. Extraction of the tooth was considered inadvisable. In spite of local treatment, sloughing continued, spreading to the floor of the mouth, involving the lateral surface of the tongue and extending to the palate. A serologic examination of the blood was negative. No signs of blood dyscrasia were found. Because of the presence of spirilla and fusiform bacilli in the smear, various arsphenamine preparations were given locally and intravenously, but without improvement. The patient continued to go down hill rapidly, death ensuing September 24, 1935. On postmortem, the lesion showed necrotic tissue, with numerous leukocytes, bacteria and many foamy appearing cells. No definite etiology could be established.

This case presents a characteristic picture of pellagra unrecognized at the time. The mouth lesion could be explained as a nicotinic acid deficiency.

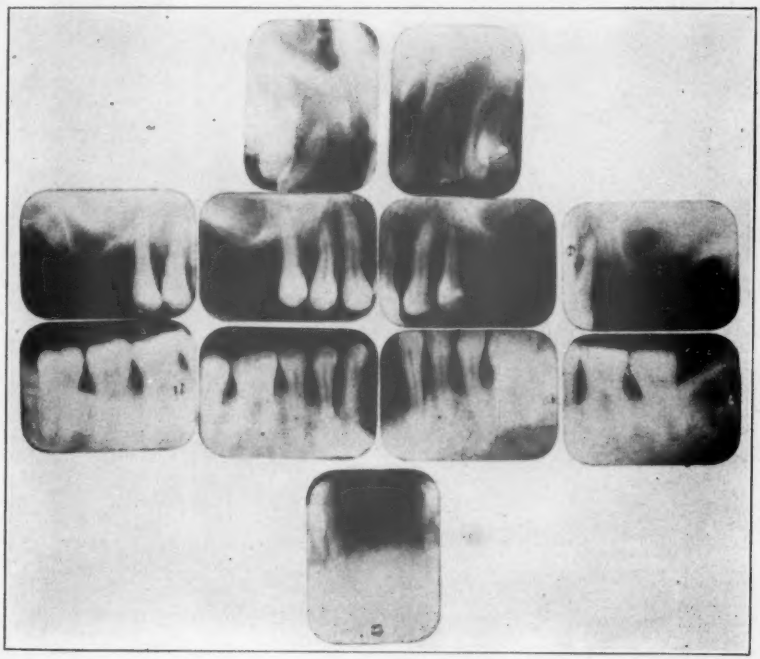

Fig. 8.—Case shown in Figure 7; marked loss of alveolar bone throughout mouth.

The other manifestations may be attributed to a deficiency of the other components of the B complex and to the hypoproteinemia.

CASE 5.—*Diabetes mellitus, mild; large ulcer of gum.*—A. S., a woman, aged 67, had diabetes mellitus, discovered in 1938. At that time, she required about 36 units of insulin daily. In January 1940, she was admitted to the hospital because of a car-

cinoma of the rectum, requiring a two-stage operation for removal. The diabetes was easily controlled by diet without insulin. About three weeks after the second operation, the patient, who was edentulous and wore a denture, developed a large ulcer on the mucosa of the ridge of the anterior portion of the mandible. In spite of the removal of the denture and local treatment, the ulcer persisted. With the administration of nicotinic acid, however, the ulcer healed in a short time. (Figs. 10 and 11.)

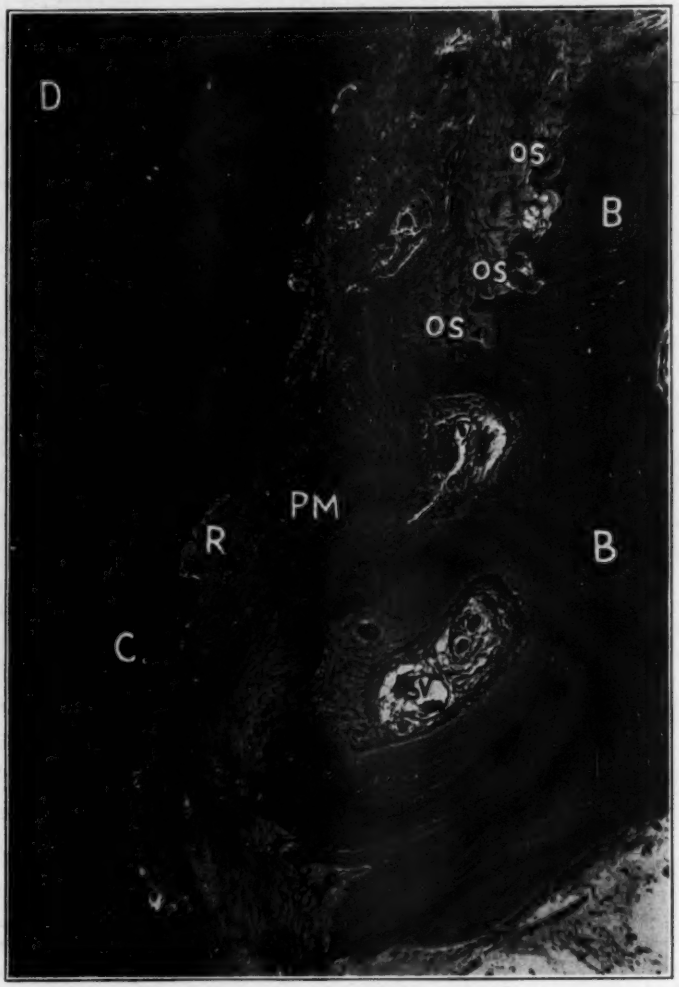

Fig. 9.—Cross-section of bone of case shown in Figures 7-8. D, dentin; C, cementum; R, resorption; PM, peridental membrane; B, bone; BV, blood vessel; OS, osteoclasts. Osteoclastic resorption and replacement of bone by connective tissue are taking place.

In this case, the ulcer in the mouth developed at the time the diabetes was under control. The patient, however, was suffering from a debilitating disease

(carcinoma of the colon), which helped to bring about the deficiency state. The response of the mouth lesion to nicotinic acid is significant.

CASE 6.—*Diabetes mellitus, mild, alcoholic; subdiaphragmatic abscess; ulceration of pharynx; beefy, red tongue.*— L. B., a man, aged 49, admitted April 1940, was a chronic alcoholic. He had developed chills and fever three weeks after a rectal abscess. At that time, a mild diabetes was discovered, which was easily controlled by diet alone. Five days before entry, the patient had developed a sore throat, which, on close observation, showed a marked ulceration of the pharynx. Twenty-four hours before admission, severe pain developed in the left flank, radiating to the left lower quadrant of the abdomen. A diagnosis of subdiaphragmatic abscess was made, with surgical intervention. After the operation, the patient was unable to take food for a few days and was kept on intravenous glucose and saline. At that time, his tongue was found to be beefy and red. With the administration of nicotinic acid, the tongue condition became normal. (Figs. 12 and 13.)

Fig. 10.—Ulcer on mucosa of woman aged 67 with mild diabetes and general debility due to carcinoma of colon.

Fig. 11.—Patient in Figure 10, after healing of ulcer following treatment with nicotinic acid.

Fig. 12.—Beefy tongue in man aged 49 with severe infection and in the presence of mild diabetes.

Fig. 13.—Patient shown in Figure 12; return of tongue to normal after treatment with nicotinic acid.

In this case, the ulcer of the pharynx, as well as the beefy tongue, was a manifestation of nicotinic acid deficiency, developing in a mild diabetes as a result of a deficient diet. The previous indulgence in alcohol and the debilitating effect of the infection may be considered as the precipitating factor.

CASE 7.—*Diabetes mellitus, severe; dry pebbled tongue; cheilosis.*—R. B., a woman, aged 52, first seen in 1939, had had diabetes mellitus for ten years. All of the teeth were extracted in 1937 because of a severe periodontoclasia. For the past few years, the patient had complained of a dry mouth and throat unrelieved by any treatment. Examination of the tongue revealed marked hypertrophy of the papillae, which gave it a pebbled appearance. During the year 1939, a severe cheilosis—fissures at the angles of the mouth—developed and, on one occasion, the patient complained of cracks between her fingers. (Figs. 14, 15, 16 and 17.)

Fig. 14.—Dry pebbled tongue in woman aged 52 with severe diabetes of ten years' duration.

Fig. 15.—Patient shown in Figure 14; cheilosis (fissures in corners of mouth).

The cheilosis responded fairly well to the administration of riboflavin, while the pebbled tongue showed definite signs of improvement only after large doses of riboflavin. The cracks on the hands disappeared with the use of nicotinic acid.

Fig. 16.—Patient shown in Figures 14-15; marked improvement of tongue following treatment with riboflavin.

Fig. 17.—Patient shown in Figures 14-16; disappearance of cheilosis following treatment with riboflavin.

In this case, the mouth manifestations indicated a deficiency of vitamin B complex.

CASE 8.—*Diabetes mellitus, severe; smooth tongue; cheilosis; diabetic neuropathy with neurogenic condition of the bladder.*—A. M., a woman, aged 70, admitted to hospital in 1939 for amputation of the left leg because of gangrene, had had diabetes mellitus for twenty-two years. On admission, the patient was very debilitated, the skin was dry and there was generalized edema. The pupils were small and did not react to light. The knee jerks were absent. The tongue was smooth and there had been marked cheilosis—fissures at the angles of the mouth—for several years. After amputation of the leg, the patient was unable to void urine and drainage was necessary for more than six weeks. (Fig. 18.)

This patient presented a multiple deficiency due to the lack of the various components of the vitamin B-complex. The smooth tongue was due to a nicotinic acid deficiency; the cheilosis, to riboflavin deficiency; the neurologic manifestations, including the neurogenic condition of the bladder, to a lack of thiamine chloride or another component of the B-complex, at present undetermined.

Fig. 18.—Smooth tongue and cheilosis (fissures in corners of mouth).

COMMENT

The etiology and pathogenesis of the oral manifestations in diabetes mellitus are still unsolved. Rutledge,[2] in a clinical and roentgenographic study of twenty diabetic children between the ages of 8 and 18, revealed that gingival and parodontal disturbances are frequently present. He asserts that, in sixteen cases (80 per cent), definite symptoms of gingivitis, vertical and horizontal atrophy and also widening of the peridental membrane space could be found alone or together. The bone structure has shown osteoporosis in four cases (20 per cent). Only one case, in a patient aged 17, showed an advanced periodontosis. This case was complicated by tuberculosis and xanthomatosis. Rutledge suggested that the periodontosis in his case was due to the xanthomatosis. We found that, in the thirteen children, repeated roentgenographic examinations revealed no changes in the supporting bone around the teeth, even when the diabetes was severe and poorly controlled, except in one case, in a patient aged 19. Four of the children showed malocclusion. In making the determination of the presence or absence of periodontosis, we are using the criteria of Thoma and Goldman[3]; namely, wandering of the teeth and vertical pocket formation.

In our adult diabetic patients, we found the marginal type of periodontitis due to calcular deposits and lack of oral hygiene. Only three cases have shown advanced periodontosis. Comroe, Collins and Crane,[4] in summarizing the literature up to 1938, noted that some patients may have difficulty in wearing dentures because of pressure pain and that one would be inclined to believe that epithelial ulcerations are caused by a vitamin deficiency and not by the diabetes itself. The response of most of the manifestations in the mouth to the vitamin therapy and the fact that the same pathologic picture can be found in any debilitating disease (Hirshfeld[5]) strongly suggest that a vitamin deficiency may be the etiologic factor. Further studies in this direction are in progress.

CONCLUSIONS

In thirteen diabetic children, ages 6 to 18, and five young diabetic adults, ages 18 to 30, we found one case with severe periodontosis.

Only three cases among the adults showed a severe progressive periodontosis, in two of which histopathologic studies were made. The cases reported illustrate that some of the manifestations in the mouth of diabetic patients are due to a vitamin deficiency of one or more components of vitamin B-complex.*

*The vitamin preparations used in these studies were supplied by Merck & Company and Hoffman LaRoche.

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ABUTMENTS AS APPLIED TO FIXED AS WELL AS REMOVABLE PARTIAL DENTURE PROSTHESIS

By EARL ALLEN NELSON,* D.D.S., Minneapolis, Minn., and F. W. HINDS,† D.D.S., Dallas, Texas

DR. HINDS: *What are the requisites of an ideal bridge abutment?*

DR. NELSON: The success of the fixed type of partial denture depends to a great extent on the abutment teeth. The ideal abutment is vital, with a healthy pulp and normal supporting tissues. It will meet any additional requirements for a reasonable period of years and maintain a satisfactory biologic status.

Another desirable quality is that the physical structure and position shall be such that the tooth can be restored with adequate retention and satisfactory appearance and function of the restoration.

The degree of importance of each of these considerations may differ in every case, depending on the condition of the remaining teeth and their investing tissues, the number of teeth lost and the amount of force exerted by the masticatory muscles.

The utilization of a tooth as a bridge abutment makes certain demands upon that tooth, such as retention and additional stress. We must remember that this is not a part of Nature's physiologic provisions.

DR. HINDS: *How can the physiologic stability of abutments and other teeth be enhanced?*

DR. NELSON: Tylman says, "When teeth are to be subjected to new forces,

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it must be definitely established that the character of the supporting bone is such that it will be able to withstand and counteract the newly imposed stresses." In other words, there must be sufficient support for the particular restoration which is to be made. Given this support, it can be maintained to the greatest advantage only by the proper distribution of the forces of mastication; that is, the newly established occlusal surfaces must be well balanced against the opposing teeth, and the occlusion of all other teeth must be corrected.

There are other factors in maintaining the stability of abutment teeth. The restorations must be so constructed that cleaning by brushing and by the use of dental floss will be easy, in order to prevent destructive pathologic processes. Another factor is that all contacts and embrasures between approximating teeth must be restored so as to prevent shifting and closing of the bite.

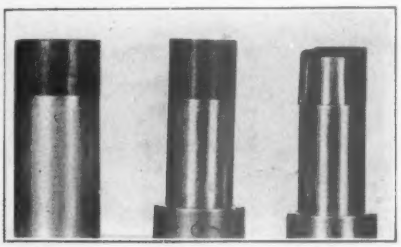

Fig. 1.—Three wax patterns made to fit steel dies at room temperature: large bulky full crown; small full crown; comparable three-quarter crown.

DR. HINDS: *What precautions must be observed to preserve the stability of abutments as well as of other teeth in cases requiring restoration of vertical dimension, commonly known as open bite cases?*

DR. NELSON: In the restoration of the majority of closed bite cases, it is necessary to balance the posterior masticating surfaces only. In the majority of persons, only the incisor teeth come in contact during the incisive action. If the posterior teeth and their supporting tissues will tolerate the forces of mastication, the anterior teeth and their supporting tissues will withstand the incising force. This being true, only partial restoration of vertical dimension is necessary. To restore a complete balance in all ranges of occlusion including the incisive movement often creates conditions which lead to failure. The most common is the lengthening of the posterior teeth to such an extent that the additional leverage placed upon their supporting bone will cause its disintegration, whereas this same investing tissue will tolerate the stress and improve its biologic status if the restoration is more conservative. Another condition created is a separation of the incisal edges of the lower from the lingual surface of the upper anterior teeth. This cannot be done in the average case with any assurance that the balance will be maintained.

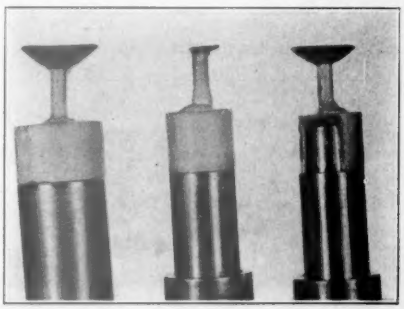

Fig. 2.—Three castings made to fit dies from three patterns in Figure 1. When materials are manipulated consistently, the expansion requirement is the same for large or small castings, provided the compensation requirement is calculated accurately. The investment was a mixture of 1 part each by weight of a high thermal expansion investment and a well-known gray investment. A thick mix and asbestos liner should always be used and casting should be into a hot (cherry red) mold.

The posterior teeth need the support

of the incisors as it is given in centric occlusion. Should the posterior teeth fail because of excessive opening, the anterior teeth are destined to fail with them. It is, therefore, propitious to open a bite only within safe limits, keeping the lower incisal edges in contact with the lingual surfaces of a properly contoured upper restoration. In other words, it might be well to live with some of the lost vertical dimension.

DR. HINDS: *What is meant by biologic considerations of abutment teeth?*

DR. NELSON: Biology is that science which deals with the phenomena of living things. To us, this means primarily the health and welfare of the tissues of the mouth. In the utilization of a tooth as a bridge abutment, it means the condition of the tooth, the pulp and the investing tissues of that tooth and of all others which form the chewing mechanism. Biology also involves a knowledge of histology, physiology, pathology, tissue reactions and the technic which we use, because these are factors in the biologic picture.

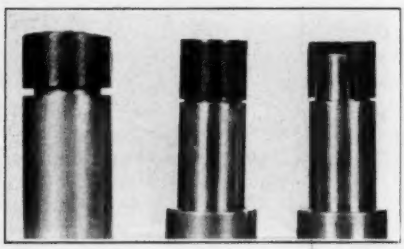

Fig. 3.—Three wax patterns made to fit dies at 95° F. subjected to a room temperature of 75° after removal from dies. A comparison with the patterns in Figure 1 illustrates the fact that patterns of a type require different degrees of compensation, depending on total material changes.

The tissues of the mouth, like other tissues, change constantly. The breaking down of normal tissue to the lower molecular forms is a part of life. This breaking down, however, is accompanied by reconstruction of tissue through normal, physiologic processes. These changes are of particular importance to us who replace lost teeth because the destruction of oral tissues in adults generally is more rapid than the formative processes.

Now, it is our duty not only to replace lost chewing segments, but also to do it in such a manner that we create a more favorable balance in the preservation of oral tissues as a whole. Surely, to do this, a knowledge of biology is necessary. This and the proper use of modern dental technics is a combination that is imperative. No biologist can do the job alone, nor can it be done by a skilled technician under the supervision of any scientist. Every properly executed cut into a tooth must be based upon a knowledge of histologic structure, biologic welfare and physiologic function in combination with the particular skill developed only by the well-trained dentist.

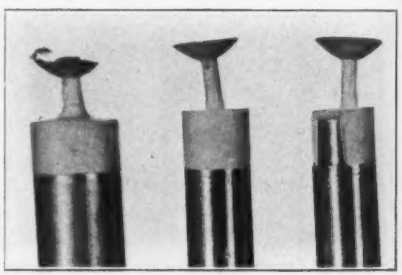

Fig. 4.—Castings made with high thermal expansion investment alone; thick mix, asbestos liner, cast hot. All castings were satisfactory, the investment expansion compensation being determined by actual material changes and not by the size or the type of the pattern. For other degrees of dimensional change, the proportions of the investment must be varied accordingly.

DR. HINDS: *How do you control pain and irritation in preparing abutment teeth?*

DR. NELSON: There are essentially two neural reactions which we must rec-

ognize: (1) the pain and irritation caused by operative procedures and (2) the subjective anticipation of what is to come. The latter is psychic and can be influenced by our actions and surroundings. Actual pain and irritation, however, are of a different nature; of utmost importance, and to a great extent within our control. Merely to eliminate pain by means of an anesthetic is a convenience, but it does not fulfil our obligation to the patient. Our responsibility is to reduce irritation to the minimum whether the patient feels it or not. On our ability to do this depends the future biologic condition of the teeth and the surrounding tissues as well as the general health of the patient.

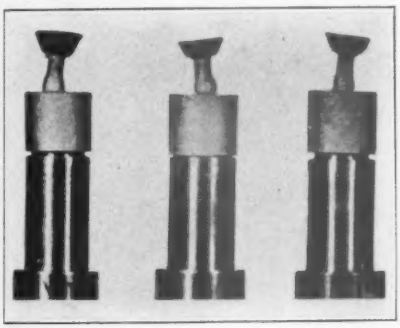

Fig. 5.—Effect of heat applied to invested pattern during time that setting expansion of investment is taking place. After investing, the temperature of the investment for the casting at the left was maintained at room temperature for thirty minutes. The temperature of the investment for the casting in the center was maintained at room temperature for ten minutes, then the temperature was raised one-half degree F. per minute for twenty minutes. The temperature of the investment for the casting on the right was maintained at room temperature for ten minutes, then the temperature was raised 1 degree F. per minute for eighteen minutes. All other factors in the casting process were equal for all three castings.

Sudden shock to the pulp, which may be caused by mechanical, thermal or chemical irritation, must be avoided. The first requisite is to use sharp chisels, sharp burs and true running stones. The stones and bur should be sprayed with warm water as they are being used. Cutting should be done quickly and with precision. The second requisite is that operative procedures be reduced to a minimum. For example, in a three-quarter crown abutment preparation of an upper bicuspid, it is often possible to complete preparation almost entirely within the enamel, going through the dentinoenamel junction only occasionally. Another precaution worthy of note is leaving the summit of the lingual cusp to project through the crown. This not only adds to mechanical retention, but also eliminates the cutting of tooth structure directly over the horn of the pulp. This area reacts most readily to mechanical, thermal and chemical stimuli.

A local or general anesthetic should be used sparingly and only when necessary. The necessity for using an anesthetic suggests the inherent dangers which accompany its use. For example, if the preparation of an abutment causes more pain than the patient can tolerate, the irritation to the pulp is proportionately severe. To believe that irritation can be minimized by the use of an anesthetic is wishful thinking. On the contrary, it can be taken for granted that its use multiplies the severity of irritation many fold in almost every case.

DR. HINDS: *Does the technic of making wax models and castings have a direct bearing on the preparation of teeth to be used as bridge abutments?*

DR. NELSON: The mechanical retention of bridge retainers is one of the prime factors in the success of such restorations. To obtain sufficient retention, castings must fit as perfectly as present-day materials permit. If a casting is too tight and it becomes necessary to grind the inner surfaces in order to seat the retainer properly, a great deal of the mechanical retention is lost. On the other hand, if a casting is too large, the

frictional wall retention may be almost entirely lost. Because of these irregularities, we are accentuating retention forms in preparation. We are extending margins, making retention grooves deeper and longer. This indicates that improvement in casting technic would conserve tooth structure, which, in turn, would save many teeth.

DR. HINDS: *In what other way is the casting technic important in the consideration of an abutment tooth?*

DR. NELSON: We prefer to use a healthy tooth in full contour as a bridge abutment. Only a well-fitting retainer gives us the right to do so. The casting technic has been improved greatly during the past few years. With each improvement, we are tempted to believe that perfection has been attained. This, however, is not true. I say this because it is easy to make better castings without additional labor or expense.

DR. HINDS: *Granted that the quality of the restoration is important in this discussion, how, briefly, can it be improved?*

DR. NELSON: The profession seemingly has accepted the idea that the amount of mold expansion necessary in the casting process depends on the size and type of the wax pattern. May I suggest that we discard this theory, because it is not scientifically correct. We must become familiar with the properties and reactions of the materials that we use. The size and type of a wax pattern or mold are not true indications of these properties and reactions. We have a tendency to believe that they are, because our flaws are more apparent in the large castings and because we often manipulate materials differently for different types of restoration. Inlay wax is one of the greatest variables. Sometimes, we adapt it to fit a die at room temperature; at other times, we adapt it actually to fit a cavity at a temperature higher than that of the mouth. In one case, we have no shrinkage before investing; in the other, we have various amounts of shrinkage. Impression materials, die materials and alloys also manifest dimensional changes during manipulation. We must learn to anticipate investment expansion in order to balance as nearly as possible the total shrinkages in each particular case.

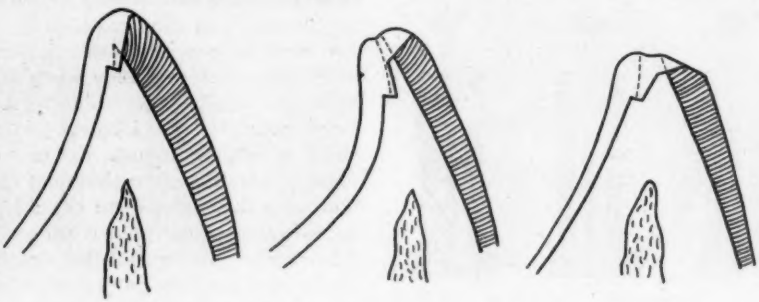

Fig. 6.—Histologic variations influencing preparation of teeth for partial veneer crowns.

The proper procedure in developing an investing technic is for each dentist to try his favorite method on a wax pattern made on a tapering steel die in such a way that it fits properly at room temperature. After it has been perfected, experiments should be conducted by making a series of patterns on the die at mouth temperature and subjecting each of them to a different room temperature after removal from the die and developing a mold expansion for each. It also

must be remembered that direct patterns are adapted at various temperatures.

Skinner calls attention to the setting expansion of investments and its relationship to heat caused by the setting action, and as to how this brings about a thermal change in the invested wax pattern. This action is very important because it is possible that we shall not make castings which fit consistently until we either learn to control it or change our materials. I have found that a gradual temperature rise of about 10 degrees F. during the period of setting expansion has enough effect on the wax pattern to allow normal setting expansion to take place, and that this reaction will affect all different types of castings approximately the same. If there is less temperature rise during the setting period, crowns will be small. If there is considerably more than a 10 degree F. temperature rise, crowns will also be small and inlays too large. This gradual rise in temperature during the period of setting expansion is just as important in the water bath as it is in the investment expansion method.

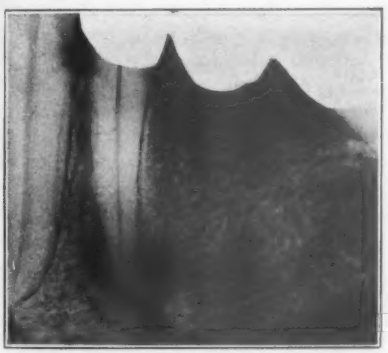

Fig. 7.—Tooth utilized as bridge abutment, with subsequent deterioration of pulp and abscess formation.

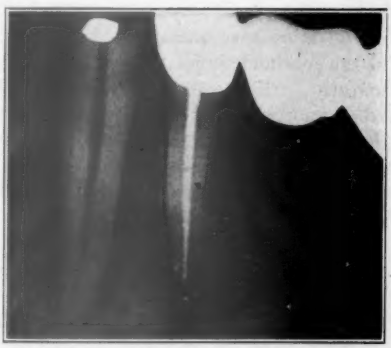

Fig. 8.—Tooth shown in Figure 7; eighteen months after treatment with formocresol and phenolsulphonic acid and filling with gutta-percha points in paste made of 1 part eugenol, 16 parts beechwood creosote, 1 part iodoform powder and 16 parts zinc oxide powder, as used by A. S. Wells.

DR. HINDS: *How do histologic variations influence the preparation of teeth for partial veneer crowns?*

DR. NELSON: The outstanding example of histologic variations is found in the incisal edges of anterior teeth. Three entirely different conditions and variations of each must be recognized. The first is a normal tooth with the incisal enamel rods almost parallel to the long axis of the tooth. (Fig. 6, left.) In preparing this type of tooth for a partial crown, the incisal edge is beveled for clearance. The incisal step can then be made entirely within this bevel; the deepest part of the step being placed in the dentin, and a bevel made from the angle to the labial margin. This condition, however, is very seldom found, as most crowns and bridges are made for adult patients; but, strangely enough, this type of incisal step is the one commonly taught as being typical.

The second condition is that of worn upper anterior teeth. (Fig. 6, center.) These teeth are abraded in various degree, often having the dentin exposed. In our practice, we encounter this condition more often than any other. If we make the usual incisal bevel for clearance and then make the usual step within this bevel, we shall surely undermine the incisal enamel rods, because the rods in

this case are not nearly parallel to the long axis of the tooth, but may be at an angle of 50° or more to the long axis of the tooth. In the preparation of this type, if a step is to be used at all, it must be made entirely lingually to the labial plate of enamel, and there cannot be a bevel from the angle of the step into the labial enamel at any point without separating the enamel from its dentin support.

The third condition, which is the most difficult, is that of the lower anterior teeth which have a labial abrasion. Here again, it is necessary to bevel the labial plate of enamel rather than the labial end of the rods. (Fig. 6, right.) It is not necessary, however, to extend the incisal margin to the true labial surface of the tooth. It is justifiable to place the margin within the worn area of the labial enamel, but it must never be made lingually from the labial plate if any dentin is exposed. An incisal step can be used if placed entirely within the dentin and lingual enamel.

DR. HINDS: *Would you ever consider using a devitalized tooth as a bridge abutment?*

DR. NELSON: The value of a devitalized tooth as an abutment has to be balanced against possible pathologic conditions which may be the cause of general systemic disorders. The answer to the question, however, is decidedly "yes," with the provision that the roentgenogram shows the tooth to be in a condition generally considered by the profession to be healthy for the particular patient who is to have the restoration. In this connection, we must realize that a devitalized tooth is no more hazardous as an abutment than it is as a single unit.

The percentage of successes of present-day methods seems to justify the treatment and retention of some teeth in which the pulp has been destroyed, particularly certain single-rooted teeth. The same underlying reasons plus others would justify their use as bridge abutments, if needed for that purpose. The utility of a devitalized tooth is secondary to the patient's health, but becomes important when many other units have been lost or the supporting tissues of the remaining teeth have been partially destroyed. In such cases, the retention of a devitalized tooth and its use as an abutment often make possible an efficient restoration; whereas, in some of these cases, the loss of any existent unit may mean a hazardous loss of stability or even the early loss of the entire natural masticating mechanism.

DR. HINDS: *What types of retainers do you prefer on various teeth, and why?*

DR. NELSON: The choice of type of retainer is based upon: (1) the amount of retention which is necessary in the particular case; (2) the condition of the abutment teeth, and (3) esthetics. As retention is the primary requisite and the full crown or some modification of the full crown possesses the greatest retentive value, I favor it above all other types of retainers for use on posterior teeth. Use of this type of retainer is also the most satisfactory means of restoring lost tooth contours. Because of the appearance, however, the use of the full crown is limited to posterior teeth or badly broken-down anterior teeth where gold in combination with porcelain or acrylic resin is advisable. The partial veneer or three-quarter crown, because of its esthetic value, is usually indicated on the anterior teeth, including the bicuspids. One frequent exception to this rule is the small lower bicuspid, which may require a full crown for adequate retention. The inlay is generally the least desirable of all types of bridge retainers.

DR. HINDS: *What are the indications and contraindications for the use of inlays as fixed bridge retainers?*

DR. NELSON: An inlay is the opposite of a crown or partial crown in almost every respect. An inlay fits within a tooth and thereby weakens it, while a crown fits around a tooth and thereby

strengthens it. The bulk of metal which forms an inlay is small and essentially in the form of a rod. It therefore lacks strength, while the specific form of a crown tends to make it more rigid. The resistance form of an inlay is confined to a small area. Because of this, it lacks the ability to withstand strain. Again, the form of a crown is the ideal for withstanding strain. To these considerations must be added the fact that an inlay encroaches upon the pulp much more than does a crown.

This does not mean that an inlay should never be used as a bridge retainer. On the contrary, in a small percentage of cases, its use is indicated. I refer especially to cases wherein molar or bicuspid abutments have been affected by caries or have been partially restored. Here, it is possible to place an inlay retainer with less destruction of the tooth than is required in preparation of a crown abutment. However, the inlay should be used in these cases only when the force exerted on the retainer is well within the ability to tolerate it. This qualification usually limits the use of inlays as retainers in fixed bridgework to replacement of a single bicuspid or other single unit if a "stressbreaker" connector is employed.

As time goes on, I use fewer and fewer inlays as bridge retainers and never use "slice" inlay restorations for that purpose.

DR. HINDS: *What are some of the means of conserving tooth structure in the practice of partial denture prosthesis?*

DR. NELSON: The first requisite for conserving tooth structure is the choice of that type of retainer and appliance which requires the least cutting of the normal tooth and at the same time will meet all requirements. For example, if a fixed bridge is made to replace the upper second bicuspid and first molar, it is usually necessary to place a three-quarter veneer crown on the first bicuspid. On the other hand, if the second bicuspid only is missing, and there are either carious areas or previously made fillings in the first bicuspid, a mesiodistoclusal inlay would be the most conservative retainer. The operation may be limited to a distoclusal inlay if a "stressbreaker" connector is used between the bicuspids.

This brings us to the second important factor in conservation of tooth structure, the type and design of the restoration as a whole. It is my belief, based upon practical experience and clinical observation, that the fixed type of bridgework is more conservative than the removable type. Particularly if the intracoronal, or so-called "precision," attachment is used, retainers for removable partial dentures require more extensive encroachment upon the pulp and possible weakening of the tooth. If the extra-coronal or clasp attachment is used, the retainer must cover more of the tooth surface than is generally required for fixed bridgework. If no retainer is used and a clasp is fitted directly to the enamel, decalcification usually follows, and this is more detrimental than the presence of a retainer.

DR. HINDS: *Should the gingival margins of crowns and inlays always extend below the free gum margin?*

DR. NELSON: In any restoration, extension toward the gingival margin is a relative factor. While the gum has to be considered, it is not a true index as to the limits of extension. Any restoration should be extended toward the gingival margin just as far as the reasons for making it dictate, but no farther. The primary reasons for extension are: to gain sufficient retention, to replace lost contours of a tooth and to cover those portions of a tooth which may soon be affected by decay.

There are also good reasons for not extending restorations any farther than necessary to meet the above-mentioned requirements: (1) the unnecessary destruction of tooth structure; (2) the fact that the more extensive the restoration, the more difficult it is to make it ac-

curate, and (3) the difficulty encountered in finishing a margin below the gum cuff. To these might be added such a secondary reason as jeopardizing the vitality of the pulp and the health of the gingival tissues.

DR. HINDS: *Why and how do you protect abutment teeth from the time they are prepared until the finishing of the restoration?*

DR. NELSON: During this interval, the abutment teeth should be protected from thermal and chemical shock. This is accomplished satisfactorily by cleaning and slightly drying the abutments, after which they should be treated and covered until the next sitting. The treatment consists of painting the freshly cut surfaces with eugenol in the case of partial veneer crowns, using a 25 per cent solution of silver nitrate for full crowns and phenol for the deeper inlay cavities.

The protective covering for anterior teeth consists of baseplate guttapercha fashioned around the tooth and packed into the interproximal spaces for retention. For the posterior teeth, a copper band is fitted slightly larger than the tooth, contoured at the gingival aspect and cut short of the occlusal surface. It is then filled with a warm temporary stopping and pressed into place. A piece of baseplate guttapercha is then warmed, pressed over the occlusal surface and trimmed to the edge of the band. This guttapercha protects the occlusal surface and prevents extrusion.

Before the cementing process, the abutments should be cleaned carefully with a medium the nature of which depends on the condition of the teeth. Hydrogen peroxide or phenol can safely be used in all cases. The abutments should be dried with warm air before cementation, with care to avoid excessive dehydration.

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APPRAISING THE DENTAL HEALTH PROGRAM

By JOHN W. KNUTSON,* D.D.S., Dr.P.H., Washington, D. C.

. . . The health officer occupies the position of an agent to whom the public entrusts certain of its resources in public money and cooperation, to be so invested that they may yield the best returns in health; and in discharging the responsibilities of this position, he is expected to follow the same general principles of procedure as would a fiscal agent under like circumstances.

As various lines of activity are suggested to him by contemporary practice or urged upon him by special propagandists, it is his duty to consider what returns are to be expected from each one and to decide how much of his capital he will put into each one. Since his capital comes entirely from the public, it is reasonable to expect that he will be prepared to explain to the public his reason for making each investment, and to give them some estimate of the returns which he expects. Nor can he consider it unreasonable if the public should wish to have an accounting from time to time, to know what returns are actually being received and how they check with the advance estimates which he has given them. Certainly any fiscal agent would expect to have his judgment thus checked and to gain or lose his clients' confidence in proportion as his estimates were verified or not.

THE foregoing quotation is from a paper presented at the fifty-third annual meeting of the American Public Health Association by Wade Hampton Frost.[1] Acceptance of his views on the relationship of the health officer to his employer, the public, is essential to an acknowledgment of the responsibilities that the dental health officer has as an accountable public agent.

It is readily acknowledged that the working capital which the public has entrusted to its health agents for investment in dental health is a mere pittance. We, the agents, could with ease rationalize a lack of demonstrable income from these investments, on the premise that expected dividends are largely a function of employed capital. We could argue that the youth of public health dentistry as an entity in the field of public health entitles it to a period of freedom from accountability. We could contend that the public itself is at fault because of its failure to compensate for deficiencies in monetary capital by a generous cooperation. However, the recent accounting on the dental health status in this country rendered by the Selective Service boards revealed that we have on our hands a major health problem, a problem the solution of which has usually been relegated to the rôle of an extracurricular activity by health officials, and which has remained unsolved by an attack which amounted to dabbling around the edges and mopping up the ruins. Here is a health problem which calls for the treatment usually accorded a major problem. Under these circumstances, it would be well for us to forego rationalization, cut short our adolescence, assume that the public has withheld its capital and cooperation because of our failure to demonstrate tangible dividends and critically examine our problem and past performances for errors and shortcomings in our work program.

Read before the American Association of Public Health Dentists, Houston, Texas, October 27, 1941.

From the Division of Public Health Methods, National Institute of Health, United States Public Health Service, Bethesda, Maryland.

*Passed assistant dental surgeon, United States Public Health Service.

The examination might be made in the following order:

1. Define the general and specific purposes of a dental health program.

2. Examine the hazards to dental health to determine what can be done to eliminate or reduce those hazards.

3. Determine the magnitude of the problem. How much work is involved in its solution? Who is going to do the work and how much will it cost?

4. Consider what means can be employed to measure the progress or success of the program. In other words, what tangible dividends in health accrue to the public investing the capital and cooperation?

PURPOSE OF A DENTAL HEALTH PROGRAM

The general purpose of a dental health program is to maintain the dental health of a community at the optimum level. More specifically, its principal purpose is to prevent tooth loss; that is, to keep teeth alive, healthy and in proper position for the performance of their normal functions.

What are the hazards to dental health? The two major causes of dental ill-health are dental caries and pyorrhea. The first of these, dental caries, is characterized by a disintegration of tooth structure and is almost the sole cause of loss of teeth in children and adults up to 30 or 35 years of age. The second, pyorrhea, which is characterized by a degeneration of the investing tissues of the teeth, is the major cause of tooth loss in persons aged 35 or older. Because the loss of teeth from caries is the first hazard to dental health encountered and because the malocclusion resulting from early loss of teeth is an important precursor of pyorrhea, it seems logical to attack the dental caries problem first.

What can be done to prevent or control dental caries? There are many theories as to the cause of this disease and many methods have been suggested for controlling it. At present, the only known practical method of preventing or indefinitely postponing the loss of teeth attacked by dental caries is early treatment whereby the carious portion of the tooth is removed and is replaced by dental filling material. The worth of this method of treatment of carious teeth has become established through many years of use, and quantitative data recently presented support its acknowledged effectiveness in preventing tooth loss.[2, 3] Additional evidence of the value of dental fillings is afforded by a comparison of certain dental findings in school children of Hagerstown, Md., with those of school children in Nicollet County, Minnesota. (The Hagerstown dental data used to make this comparison were published in THE JOURNAL.[4] The Nicollet County dental findings are based on a recent dental survey made by the United States Public Health Service in cooperation with the Minnesota Department of Health. The methods used in collecting and analyzing these data have been published.[5, 7]) Comparison indicates that the age specific caries prevalence rates in the permanent teeth of Nicollet County chil-

TABLE 1.—NUMBER OF ELEMENTARY AND HIGH SCHOOL CHILDREN, BY AGE AND SEX, WHO HAD DENTAL EXAMINATIONS, NICOLLET COUNTY, MINNESOTA, 1940

	Age Last Birthday													
	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
Boys	137	131	140	159	139	127	142	127	83	65	41	48	12	1,351
Girls	122	121	136	123	137	138	147	104	76	77	52	31	12	1,276
Both Sexes	259	252	276	282	276	265	289	231	159	142	93	79	24	2,627

dren are consistently higher than those of Hagerstown children (Fig. 1), yet the tooth mortality rates of Nicollet County children are consistently and materially lower than those of Hagerstown children (Fig. 2). This reversal of the expected relationship of the tooth mortality trends in these two groups of school children is apparently accounted for by the finding that the level of dental care (fillings) is roughly twice as high in Nicollet County children as in Hagerstown children (Fig. 3).

TABLE 2.—TOTAL NUMBER OF PERMANENT TEETH AFFECTED BY SPECIFIED CONDITIONS IN 2,627 ELEMENTARY AND HIGH SCHOOL CHILDREN BY AGE, NICOLLET COUNTY, MINNESOTA

	Age Last Birthday												
	6	7	8	9	10	11	12	13	14	15	16	17	18
	Number of Permanent Teeth												
Decayed, requiring fillings (D)*	113	258	368	443	468	524	673	621	407	431	206	171	56
Missing (M)†	1	2	16	20	29	50	111	74	87	116	95	87	26
Filled (F)	20	112	274	373	489	599	891	828	786	863	604	623	197
DMF‡	133	360	636	805	937	1103	1589	1459	1223	1366	891	856	269
	Number of Permanent Teeth per Child												
Decayed, requiring fillings (D)*	0.436	1.024	1.333	1.571	1.696	1.977	2.329	2.688	2.560	3.035	2.215	2.164	2.333
Missing (M)†	0.004	0.008	0.058	0.071	0.105	0.189	0.384	0.320	0.547	0.817	1.022	1.101	1.083
Filled (F)	0.077	0.444	0.993	1.323	1.772	2.260	3.083	3.584	4.943	6.077	6.495	7.886	8.208
DMF‡	0.514	1.428	2.304	2.855	3.394	4.162	5.498	6.316	7.692	9.620	9.581	10.835	11.208

*All teeth with one or more untreated carious areas except those teeth indicated for extraction.
†Extracted teeth and teeth indicated for extraction.
‡Decayed, missing and filled teeth. A tooth both decayed and filled is counted as one DMF tooth.

DENTAL NEEDS

Continuing the examination of our problem: How practical is this method, that is the filling of carious teeth, for preventing their loss? In other words, what is the size of the yearly crop of carious defects, how many dentists are necessary to correct these defects, and how much will the job cost?

Many surveys on the prevalence of dental defects in children have been made during the past decade. Of the data resulting from these surveys, those pertaining to Hagerstown, Md., school children have been most extensively analyzed.[4, 5, 6] This analysis revealed that, beginning with age 6, the permanent teeth of school children were being attacked by caries at the markedly constant rate of nine-twelfths or three-fourths of a tooth per child per year, so that, by the age of 18 years, an average of nine teeth had been attacked per child (Fig. 1). The attack rate for the Nicollet County, Minnesota, children was found to be a trifle higher, eleven-twelfths of a permanent tooth per child per year; that is, children aged 18 had

accumulated an average of eleven carious permanent teeth over the twelve-year period 6 to 18 years (Fig. 1). These and other surveys have demonstrated that the caries attack rate varies from community to community. However, an analysis of the findings presented in Public Heath Bulletin 226,[8] which reports the dental findings in roughly 1,500,000 children aged 6 to 14 years from communities in twenty-six states, indicates that the mean caries attack rate for these communities is approximately the same as that for Hagerstown children.

accumulate 22,500,000 carious permanent teeth per year, and a like number of hours of service needs under the assumption that it would require one hour to fill each carious tooth. The 70,000 dentists in this country each represent 1,800 potential service hours per year, or a total of 126,000,000 hours. Since the filling of the annual crop of carious defects in the permanent teeth of children aged 6 to 18 would require 22,500,000 of the 126,000,000 available service hours, this means that only 18 per cent of the dentists' total time would be required to

TABLE 3.—NUMBER OF GRADE SCHOOL CHILDREN WHO RECEIVED "100 PER CENT CORRECTION" DENTAL CARDS, AND NUMBER AND PERCENTAGE WHO ACQUIRED "100 PER CENT CORRECTION" STATUS* BY SCHOOL YEAR, FOR WAYNESBORO, PA., 1931-1939

	School Year							
	1931-1932	1932-1933	1933-1934	1934-1935	1935-1936	1936-1937	1937-1938	1938-1939
Number of children given 100 per cent correction cards	1,070	1,196	1,418	1,423	1,436	1,037	1,018	980
Number of children acquiring 100 per cent correction status	259	253	457	504	690	803	851	861
Percentage of children acquiring 100 per cent correction status	24.2	21.2	32.2	35.4	48.0	77.4	83.6	87.8

*100 per cent correction status is acquired by returning the card with a dentist's signature as evidence that needed dental treatment has been obtained.

PROFESSIONAL DENTAL PERSONNEL NEEDED

The next question to be answered in determining the magnitude of our job is what proportion of the available professional services would be necessary to perform the task of filling the annual crop of carious defects in permanent teeth of children aged 6 to 18 years. According to the 1940 census,[9] these children constitute 26 per cent of what is usually considered the "dental population," or persons between the ages 2 and 65 years. At the rate of three-fourths of a carious permanent tooth per year, these children, numbering roughly 30,000,000, would meet this particular class of dental need in 26 per cent of the dental population. In other words, if children in the age span under consideration were given their proportionate share of the total professional services available, slightly more than two-thirds of the service time allotted to them would be required to fill carious defects arising each year in the permanent teeth, and slightly less than one-third of that time would be available for prophylaxis, roentgenography, the filling of carious deciduous teeth, etc. (Proportionate share as used here refers to the results obtained by

using population as a base. The true base, dental needs, is not available. However, it is generally acknowledged that the use of dental needs as a base would operate to allocate a relatively larger share of the available professional service to the group 6-18 years than is here allocated, using population as a base.) Whether this would allow sufficient service time to care adequately for these later service needs is a moot question. However, in considering the answer to this question, we must remember that service for the complete care of deciduous teeth must begin at age 2, and only the service needs

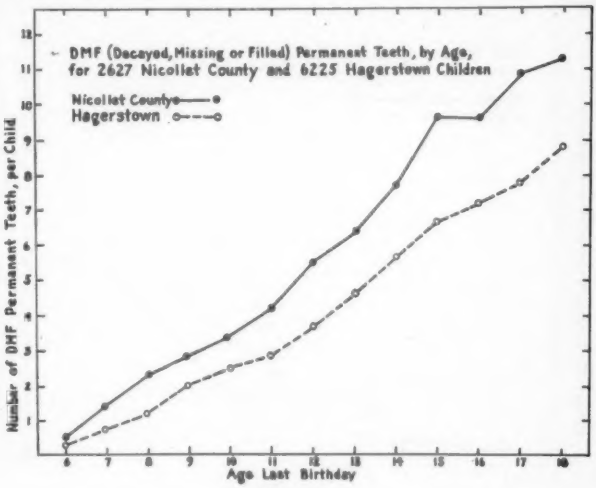

DMF (Decayed, Missing or Filled) Permanent Teeth, by Age, for 2627 Nicollet County and 6225 Hagerstown Children
Nicollet County
Hagerstown
Number of DMF Permanent Teeth, per Child
Age Last Birthday

Figure 1.

which arise in these teeth after age 6 should be charged to service time apportioned to the age group 6 to 18 years.

THE COST OF DENTAL CARE

Next in order for consideration is the cost of this service. If we accept $4 as an equitable average fee for filling each carious permanent tooth, it would cost a total of $36 per child to fill the nine permanent teeth which become carious during the twelve year span, 6 to 18 years of age, or $3 per child per year for the Hagerstown children. (The United States Veterans Bureau fee schedule for amalgam and synthetic porcelain fillings allows $2 for one surface, $3 for two surfaces, and $5 for three surfaces. This schedule is usually used as a basis for estimating the cost of dental care. The mean fee charged by dentists in 1929 for a two-surface alloy was $3.88, and both the median and the modal fee were $3[9]). It would cost a total of $44 for Nicollet County children, or $3.67 per year per child. An appreciation of the meaning of these cost figures can be obtained by comparison with past per capita expenditures for dental care in this country. The most comprehensive study available on the total annual expenditure for dental care in the United States is that made by Maurice Leven,[10] who estimated that, in 1929, the gross income of dentists was $446,000,000. This represents an expenditure of approximately $4 per person per year for the population then in the age group 2 to 65 years.[11] If we can assume that the present per capita expenditure for dental care is somewhere near that of 1929 or that it is desirable and feasible to make a like expenditure, we need ask

little more than that children between the ages of 6 and 18 years of age be given their proportionate share of the expenditures and that the allotted funds be expended in the most effective manner to prevent tooth loss.

If it is theoretically possible with existing professional personnel and at approximately the current rate of expenditure for dental service to care adequately for the permanent teeth of children aged 6 to 18 years, what then is the basis for the report that only 20 per cent of our population is receiving adequate dental care[12] and for the more recent report[13] of the Selective Service boards? Two answers are possible: First, the theoretical calculations are in error or, second, something is radically wrong with the manner in which dental care is now being procured. With reference to the first of these, the greatest weakness in the calculations presented is the fact that they are based on several idealistic assumptions. For example, it is assumed that the present professional dental facilities in this country can be placed on a full-time production basis. It is also assumed that methods can be developed for making adequate dental care available to all, regardless of economic status. Finally, it is assumed that the low cost type of dental care, such as is represented by amalgam and synthetic porcelain fillings, can be considered adequate dental care.

With reference to the manner in which dental care is now being procured, it is readily acknowledged that a large proportion of the dental service now being dispensed is concerned with the replacement of lost teeth. The obvious fact that the replacement of teeth by elaborate and expensive appliances is far more costly than preventing the loss of teeth by relatively inexpensive fillings has given rise to the expression "The best dental care is by far the most economical." To illustrate: In the Hagerstown children aged 18 years, an average of nine permanent teeth had been attacked by caries. Of these, two had already been extracted because of inadequate dental service. On the assumption that it would be desirable to supply completely the dental needs of these 18-year-old children, it would now cost $28 to fill the seven fillable carious teeth, and approximately $35 to bridge

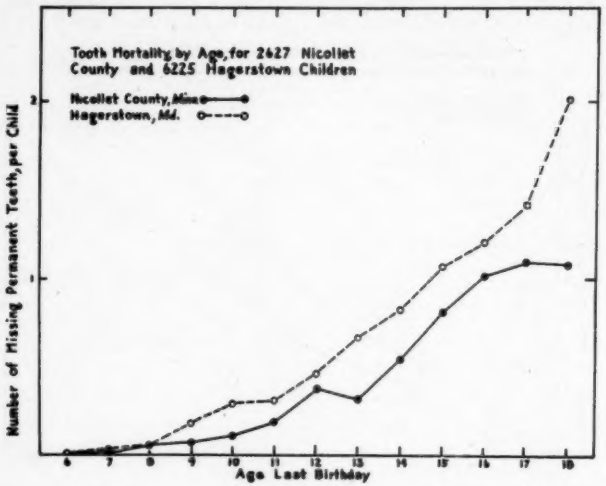


Figure 2.

in each of the extracted teeth; or a total of $98 per child; whereas, to have filled properly the nine carious teeth as they became carious would have cost only $36 per child.

WHY DENTAL PROGRAMS FAIL

Although the foregoing analysis of the practicability of our only accepted method of preventing tooth loss in childhood has been presented sketchily, this treatment is merely a reflection of the time limitation on the present discussion. A major cause of the apathetic attitude of many health officials toward the dental program is the belief that the job to be done is too enormous and the cost is prohibitive. This belief has resulted largely from a misinterpretation of figures on dental needs. It has resulted from an examination of figures based on the average prevalence of dental defects in a population group at a given time, rather than figures based on the yearly incidence of dental defects.

The principal objective of a dental program for children can thus be simply stated as the formulation and application of procedures whereby the early detection and treatment of carious teeth are accomplished and tooth loss thereby prevented. In the past, many dental programs have been set up on the basis of this specific objective. Further, because of a recognition of the value of and need for local participation in the program, the cooperation of local individuals and groups, such as the educational authorities and teachers, the welfare board, the health agencies and personnel, the dentists and the civic and philanthropic organizations, has been enlisted. In spite of this apparent completeness of the local structure, the outcome, in general, of these programs is characterized by the term "fizzle."

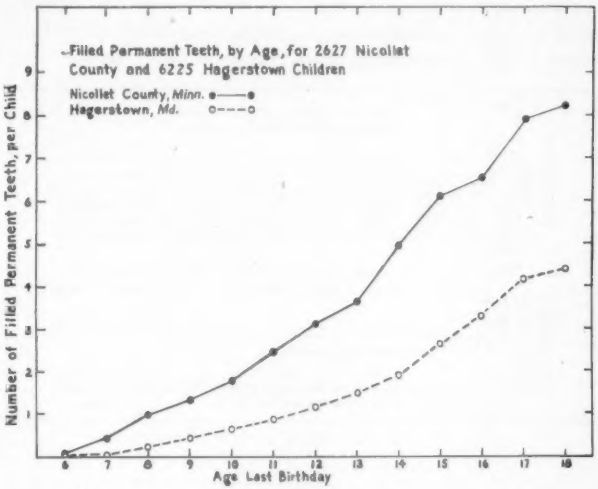

Filled Permanent Teeth, by Age, for 2627 Nicollet County and 6225 Hagerstown Children
Nicollet County, Minn. ●——●
Hagerstown, Md. ○---○
Number of Filled Permanent Teeth, per Child
Age Last Birthday

Figure 3.

The causes for the more or less universal failure of dental programs are probably exceedingly numerous. Only four of what appear to be major causes will be discussed here: 1. Lack of conviction that the objective can be attained. 2. Failure to recognize the limitations of health education. 3. Lack of local full-time personnel to do the general field work and to supply adequate follow-up service. 4. Lack of objective evidence that the program in general and

the cooperative effort in particular are having the desired results.

DENTAL HEALTH EDUCATION

The importance and origin of the first of these causes, lack of conviction that the objective can be attained, were presented in the foregoing discussion on dental needs and costs. With regard to the second cause, it is important to recognize that health education may be successful in increasing the public knowledge concerning a health problem without leading to application of the knowledge gained. In other words, knowledge does not connote action. Yet, in general, the capital entrusted to dental health officers has been invested largely in educating the public. The reason usually presented for the selection of this activity to the exclusion of all others is that the capital available is limited and dental education affords the only means of obtaining statewide coverage through a relatively small expenditure. It is only suggested here that it would be well to explore the advantages of reducing the initial coverage from a whole state to an area of such size that the available capital and personnel might be engaged in a complete dental program. This approach is in accord with that employed by most commercial concerns. Although the value of health education should not be exaggerated, its usefulness should not be lost sight of. It is an excellent tool the value of which should be considered as the farmer considers the value of fertilizer. The use of the fertilizer does not reduce appreciably the amount of field work to be done, but it does make a given amount of field work more profitable.

DENTAL HEALTH FIELD WORKERS

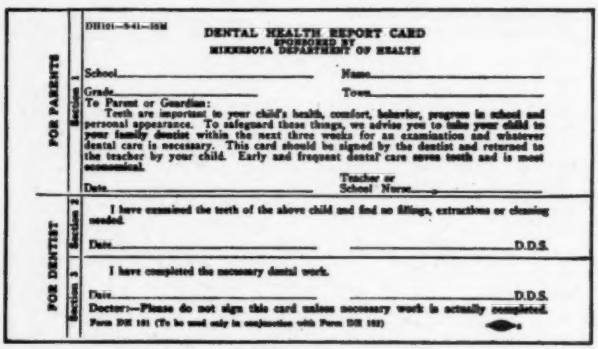
Because of the widespread prevalence of dental caries, and because our only accepted means of controlling the disease involves at least an annual examination of the teeth and early treatment of carious defects, the task which a dental program undertakes to perform is clearly a relatively huge health activity. Therefore, the need for full-time local field workers to assist in performing the task seems obvious. Some of the duties of those field workers would be as follows:

1. To allocate local responsibility for the success and continuation of the program.

2. To maintain the interest and coordinate the efforts of all cooperating groups.

3. To contact each school teacher at regular intervals in order to assist her in solving the problems that arise in connection with efforts to lead her pupils to obtain regular dental care.

4. To make home visits to parents of



DH101—5-41—5M

DENTAL HEALTH REPORT CARD
SPONSORED BY
MINNESOTA DEPARTMENT OF HEALTH

FOR PARENTS — Section 1

School _____ Name _____

Grade _____ Town _____

To Parent or Guardian:

Teeth are important to your child's health, comfort, behavior, progress in school and personal appearance. To safeguard these things, we advise you to take your child to your family dentist within the next three weeks for an examination and whatever dental care is necessary. This card should be signed by the dentist and returned to the teacher by your child. Early and frequent dental care saves teeth and is most economical.

Date _____ Teacher or School Nurse _____

FOR DENTIST — Section 2

I have examined the teeth of the above child and find no fillings, extractions or cleaning needed.

Date _____ _____ D.D.S.

Section 3

I have completed the necessary dental work.

Date _____ _____ D.D.S.

Doctor:—Please do not sign this card unless necessary work is actually completed.

Form DH 101 (To be used only in conjunction with Form DH 102)

Figure 4.

those children delinquent as to dental inspection and service.

5. To make the necessary contact between the welfare board and its clients.

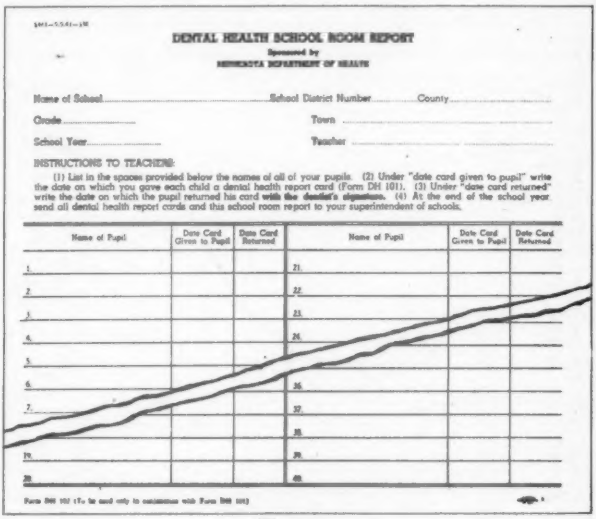
6. To interest local philanthropic and civic groups in the dental health problems of borderline cases.

7. To check on the accuracy and completeness of recording and reporting.

8. To assist in evaluating various administrative procedures and in determining the success of the program in preventing tooth loss.

It is readily acknowledged that, at the present time, we do not have trained personnel to fill such positions. However, we will never get properly trained personnel until there is a demand for persons capable of delivering such services. It is my belief that we should employ dental hygienists to fill these positions, just as the health officer was originally forced to employ the hospital nurse for public health work. Today, however, because of a continuous and sizeable demand, the health officer now has available highly specialized public health nurses. A full-time dental health worker on the spot whose major interests, duties, and responsibilities are confined to dental health problems seems an immediate necessity for the continuation and success of any community dental health program.

It is not intended that these field workers shall supplant the cooperative efforts of other health personnel, such as public health nurses, or of other groups, such as school teachers. These workers should cooperate fully with the public health nurses and avoid such undesirable practices as duplication of home calls and a general duplication of effort. The school teacher should occupy a key position in a dental program for school children. It is unlikely that grade-school children seek dental service because of a desire for something so intangible to them as dental health. It is apparent that they are motivated by something tangible, such as a material or other reward or by a desire to fulfil the wishes of some one whom they respect and admire. In other words, many more will go to the dentist simply because their teacher asks them to go than



DENTAL HEALTH SCHOOL ROOM REPORT

Sponsored by

MINNESOTA DEPARTMENT OF HEALTH

Name of School ..... School District Number ..... County .....

Grade ..... Town .....

School Year ..... Teacher .....

INSTRUCTIONS TO TEACHERS:

(1) List in the spaces provided below the names of all of your pupils. (2) Under "date card given to pupil" write the date on which you gave each child a dental health report card (Form DH 1011). (3) Under "date card returned" write the date on which the pupil returned his card with the dentist's signature. (4) At the end of the school year send all dental health report cards and this school room report to your superintendent of schools.

Name of Pupil	Date Card Given to Pupil	Date Card Returned	Name of Pupil	Date Card Given to Pupil	Date Card Returned
1.			21.		
2.			22.		
3.			23.		
4.			24.		
5.					
6.			26.		
7.			27.		
			28.		
19.			39.		
20.			40.		

Form DH 102 (To be used only in connection with Form DH 101)

Figure 5.

will go because they understand the reasons for dental service.

EVALUATING THE DENTAL PROGRAM

Finally, how are we going to evaluate our dental programs? Our first administrative task is concerned with getting children to the dental offices and clinics at proper intervals for examination and needed service. Therefore, it would be desirable to determine from time to time the public response to this effort. The use of the "100 per cent correction card" is very useful for measuring this response. It consists of a form which the child takes to the dentist and on which the dentist places his signature after all necessary dental work has been completed (Fig. 4). The completed card is then returned to the school teacher for her record. The teacher's record consists of an additional form called the school room dental health report (Fig. 5). On this form, the teacher lists the names of her pupils, the date when the "100 per cent correction card" is given to each pupil and the date when each completed card is returned.

The usefulness of these records to the individual school teacher, to the dental health worker and to cooperating groups as a progress guide is obvious. Their value as a means to evaluate response to different types of administrative tactics is also apparent. For example, an analysis[14] of data resulting from the use of the "100 per cent correction cards" in Waynesboro, Pa., indicated (Fig. 6; Table 3) that the proportion of children in the first six school grades who attained a 100 per cent correction status increased annually over an eight-year period from 24 to 88 per cent. These figures serve to indicate the relative success of the dental program in obtaining public response. A more detailed examination of the trend of this response (Fig. 6) indicates that a pronounced rise occurred during the last three years of the eight-year period studied. As this rise followed the introduction of an added stimulus (the manager of the local

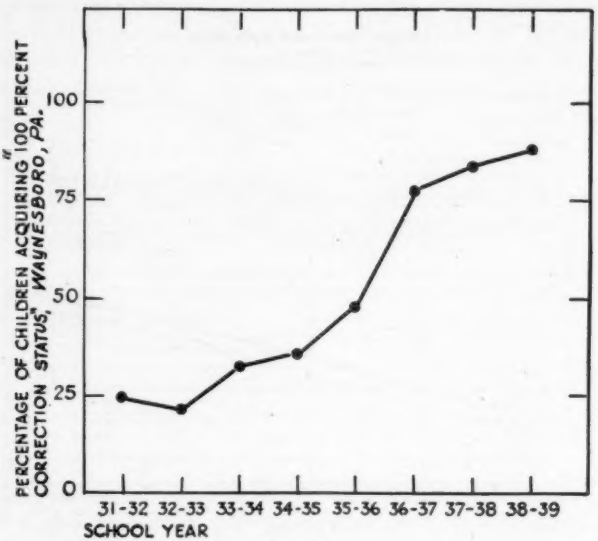
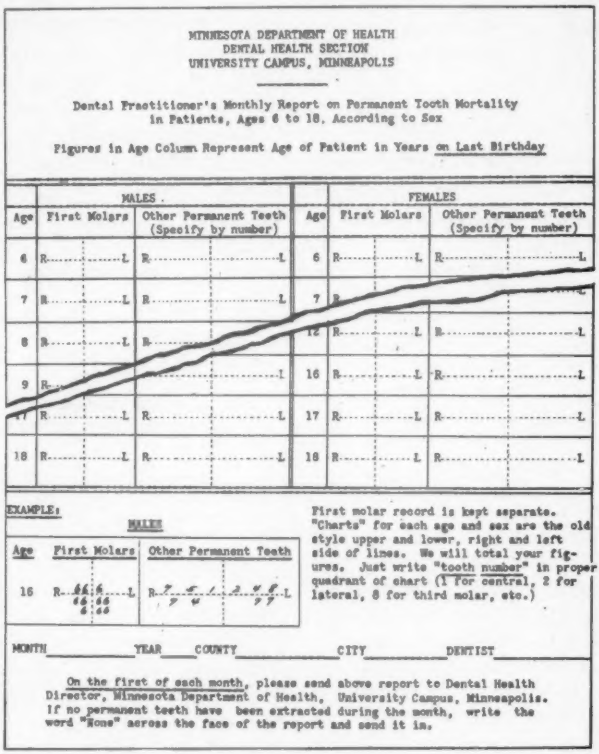


Figure 6.

theater offered a movie ticket to each child attaining a 100 per cent correction status), a further specific use of these records is suggested; namely, to determine the relative merits of different administrative tactics in increasing public response.

However, we must not forget that the figures available from the use of record forms such as the "100 per cent correction card" merely measure the progress that we are making in applying acknowledged means of preventing tooth loss. They do not measure the specific progress being made in attaining our final objective, that of preventing or reducing tooth mortality.

The dental profession is notoriously void of any specific quantitative data on the progress made in solving its health problems. No one of us knows or can determine what progress our profession has made during the last five, ten, twenty or fifty years in reducing or eliminating the hazards to dental health. On the other hand, our colleagues in the medical profession have made extensive use of quantitative data to demonstrate the size and nature of their problems and the progress being made in solving them. For example, they can show quantitatively that the crude death rate has been almost halved during the past fifty years. They can show that the risk of death from smallpox has been almost eliminated. They can show that the infant mortality



MINNESOTA DEPARTMENT OF HEALTH
DENTAL HEALTH SECTION
UNIVERSITY CAMPUS, MINNEAPOLIS

Dental Practitioner's Monthly Report on Permanent Tooth Mortality in Patients, Ages 6 to 18, According to Sex

Figures in Age Column Represent Age of Patient in Years on Last Birthday

MALES			FEMALES		
Age	First Molars	Other Permanent Teeth (Specify by number)	Age	First Molars	Other Permanent Teeth (Specify by number)
6	R L	R L	6	R L	R L
7	R L	R L	7	R L	R L
8	R L	R L	12	R L	R L
9	R L	R L	16	R L	R L
17	R L	R L	17	R L	R L
18	R L	R L	18	R L	R L

EXAMPLE:

MALE

Age	First Molars	Other Permanent Teeth
16	R 6 6 6 6 L	R 7 4 1 3 4 7 L

First molar record is kept separate. "Charts" for each age and sex are the old style upper and lower, right and left side of lines. We will total your figures. Just write "tooth number" in proper quadrant of chart (1 for central, 2 for lateral, 3 for third molar, etc.)

MONTH_____ YEAR____ COUNTY_____ CITY_____ DENTIST_____

On the first of each month, please send above report to Dental Health Director, Minnesota Department of Health, University Campus, Minneapolis. If no permanent teeth have been extracted during the month, write the word "None" across the face of the report and send it in.

Figure 7.

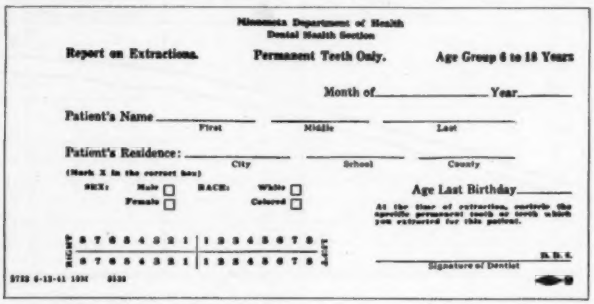
rate has been reduced from 86 to about 40 per thousand within the past twenty years. They can show that the pneumonia death rate has been reduced by more than a third through the use of new therapeutic methods during the past five years; etc. They are able also to demonstrate that such hazards to life as cancer and heart disease are their unsolved problems. But, quantitatively, they can do a good job of justifying their expenditures of capital and effort; whereas we dentists have almost nothing quantitative to justify ours.

TOOTH MORTALITY RATES

Since our objective is to prevent tooth loss, accurate figures on our progress in reducing tooth loss would be of tremendous value in appraising our methods and performances. It was shown early in this discussion, by reference to a previous study,[2] that some dental care had reduced tooth loss by roughly 60 per cent in a group of Hagerstown boys, and that Nicollet County children had lost significantly fewer permanent teeth than Hagerstown children apparently because of differences in the level of dental care. These comparisons were made possible through direct counts of missing teeth. If such counts were made periodically in a given population group, data would be afforded for measuring progress in reducing tooth loss. However, this method of securing data involves the use of the census or enumeration method, which is time consuming and expensive. But why not use the registration method, the method that physicians have been using with great success? Why not have the dentist report the extraction of permanent teeth, or "deaths in a tooth population," just as the physician reports deaths in the human population?

REPORTING TOOTH DEATHS

The reporting of extractions of permanent teeth in children aged 6 to 18 years was begun by the dentists in Nicollet County, Minnesota, in November 1940. Since that time, the dentists in three adjacent counties have volunteered to make, and are making, similar reports. The original reporting form used (Fig. 7) has undergone considerable revision. The form being used at present (Fig. 8) will undoubtedly undergo further changes, although its advantages over the original are many.


Minnesota Department of Health
Dental Health Section

Report on Extractions. Permanent Teeth Only. Age Group 6 to 18 Years

Month of _____ Year _____

Patient's Name _____ First _____ Middle _____ Last

Patient's Residence: _____ City _____ School _____ County

(Mark X in the correct box)

SEX: Male ☐ Female ☐ RACE: White ☐ Colored ☐

Age Last Birthday _____

At the time of extraction, encircle the specific permanent teeth or teeth which you extracted for this patient.

RIGHT 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 LEFT

8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8

D.D.S.

Signature of Dentist

Figure 8.

The data that these reports attempt to collect are the name, age, sex and residence of the child for whom the extraction or extractions are performed. The specific tooth type and position of the tooth extracted is also indicated. These reports are intended to make possible the allocation of cases and determination of the specific tooth mortality rates in children aged 6 to 18 years for a given com-

munity. The reports are made to the state health department on a monthly basis, each dentist reporting the extractions performed, or the fact that none were performed, during a given month.

During the past ten months, the nine dentists in Nicollet County have reported a total of 166 permanent teeth extracted in the age group 6 to 18 years, or an average of slightly less than two extractions per dentist per month. This figure is of especial interest because of the fact that any initial resistance to filing such reports is based on the erroneous belief that a tremendous burden of record keeping will be placed on the individual dentist. An example of the simplest, most direct use of data collected by these records can be given if we assume that a total of 200 permanent teeth will be extracted in the population group age 6 to 18 in Nicollet County during the year 1941. Then if the total is reduced to 150 in 1942, to 100 in 1943, and so on, the value of these figures becomes apparent. Further, if a reduction is not accomplished, the established fact will serve to initiate a study into the shortcomings of the program.

That there are weaknesses in this system and deficiencies in the figures obtained is readily admitted. However, the worth of the system to the dentists making the reports, to the health officials and eventually to the cooperating groups, seems great enough to warrant continuation and study of the method on an experimental basis with a view to surmounting the difficulties. The necessity for developing simple methods for evaluating dental programs is admittedly great. This method of providing the necessary data for making the evaluation is simple and inexpensive and therefore offers hope.

SUMMARY

Dental health officials of local, state and federal governments are employed by the public for the purpose of attaining and maintaining an optimum status of dental health within their respective jurisdictions. These officials occupy the rôle of efficiency experts whose duty it is to develop means and methods whereby dental health is preserved in a feasible manner and at a minimum cost. Though the means for reducing the risk of losing teeth from dental caries, for example, involves visiting the dentist at proper intervals for the early detection and treatment of carious teeth, the dental health official's duty does not end with telling the public about this fact. He is responsible for making the means available to all and for developing methods which will insure the effective use of that means. Further, as an accountable public agent, he must demonstrate that his job is being done. He must treat all cooperative public effort as well as funds entrusted to him as capital and be able to show that his manner of investing that capital is justified by the dividends in dental health accruing to the public.

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PHOTOMICROGRAPHY

By SUREN M. SERON,* B.S., D.D.S., Joliet, Ill.

IN the following presentation, no attempt will be made to go into technical detail. The average person would like to know what equipment and technic are necessary for taking good kodachrome photomicrographs of stained sections.

APPARATUS

The following equipment is being used:

1. An Eastman "Recomar" camera 2½ by 3¼, double extension bellows, F. 4.5 lens. An adapter back (individual ground glass and film carrier) for bantam size kodachrome film.

2. A "Zeiss" binocular microscope with substage condenser and diaphragm.

3. For light, a standard size lantern projector that will take a No. 1 photoflood bulb. This will give a cold spot of light and eliminate extraneous light.

*Instructor in the Department of Oral Surgery, University of Illinois, College of Dentistry.

SECTION

A kodachrome reproduction will be enhanced by deeper staining of the section. Also, the section should be cut as thin as possible, as the detail will be better, particularly under the higher magnification.

LIGHT

Lighting of the specimen is of the utmost importance. Any light not of the intensity of photoflood is worthless in kodachrome photomicrography. Type "A" kodachrome needs the factors in photoflood light in order to reproduce the colors in the stained section in their true tones. Otherwise, a yellow background is noted and the stain is altered, with the resultant loss of clarity and detail.

CAMERA

The camera is free of any connection with the microscope or the top of the table, to avoid any movement of the

microscope in positioning of the camera for the "shot."

Since all the work is done in a dark room and all extraneous light is excluded, a light-tight connection is unnecessary between microscope and camera. This simplifies positioning and prevents movement of the microscope. The lens of the camera is advanced three-fourths inch on its slide from the closed position.

EXPOSURE TIME

Any attempt made to standardize the light to a constant factor for exposure is impractical, owing to variations of stain, thickness of section and magnification of object. Eastman gives a technic requiring the use of trial strips of black and white film, exposure, using various times, development and fixing. The best timing is thus obtained and a kodachrome exposure made; but this consumes too much time.

Guessing is another method. Indifferent results are the rule and film is wasted.

The simplest method, I have found, for getting proper exposure time calls for an extinction type of light meter, the "Instoscope," a meter using the Scheiner scale.

The relative speed of kodachrome is comparable to that of panatomic X in black and white film.

By using panatomic X film in test shots (artificial light rating) at F.8., I obtain excellent results. Kodachrome using the same time turns out equally well. Some experimentation may be necessary, depending on the camera used.

The artificial light rating for panatomic X and kodachrome falls between 20 and 22 on the meter; for daylight, between 23 and 25.

PROCEDURE

The usual procedure is followed for photographing a microscopic section as to scope, area, sharpness, brightness, etc., as desired for the eye, just as we should like to see it reproduced in kodachrome. At this point, the instoscope (adjusted previously for the eye) is placed over the eyepiece of the microscope. The light will illuminate the letters of the instoscope. The last letter readable, after looking for at least ten seconds, is determined. The time at F.8 is taken from the meter.

The camera is placed above the eyepiece of the microscope about one-eighth to one-quarter inch. The section is viewed in the ground glass. A bright spot of light will be seen in the center of the ground glass. This is the "antipoint" or "Ramsden disc." When the camera is carefully moved to right or left, this spot will disappear to one side.

With the fine adjustment, the section is brought to sharp focus on the ground glass. A "pic sharp" magnifying lens will aid in obtaining a sharp focus. An exposure is made, using the time obtained with the instoscope. The camera opening is left at F4.5.

CONCLUSION

1. For proper color rendition of stains in a section, the light factors of photoflood light are necessary for kodachrome type A.

2. Proper time exposure can be consistently obtained with the extinction type of meter, the instoscope, using the time obtained under the F.8 column, and this under any power used on the microscope from the lowest power through oil immersion.

3. Sharpness and detail can be obtained only by proper focusing on the ground glass of the camera. A magnifying lens is useful.

4. Specimens should be thin and stained deeper if possible.

5. A dark room eliminates all extraneous light, facilitating focusing and obviating a light-tight connection.

Medical Arts Building.

THREE PULPLESS TEETH: A CASE HISTORY AND A CONCLUSION

By LEHMAN WENDELL, B.S., D.D.S., Minneapolis, Minn.

A MAN, of middle age, had three pulpless teeth in the upper left jaw. Being aware of the harm that may come from infected teeth, he had roentgenograms taken at frequent intervals. These were in every case pronounced negative by the men who took them.

The patient had for years suffered from lack of appetite and poor digestion. His left eye required a different lens from that required by the right. At frequent intervals, a severe pain in the heart would compel him to sit down for a few minutes. He was continually tired and never felt refreshed from a night's sleep. The entire left side seemed to be different from the right side, and he was always conscious of it. As he himself expressed it, he felt as if the Creator had made him out of two halves and had put the wrong half on the left side.

As the years went by, the condition gradually grew worse. Pain developed on the left side, centering in the arm, the shoulder, the hip, the knee and the great toe. The pain in the arm became so acute that the patient could scarcely sleep at all.

He again suspected his teeth and had them roentgenographed. "Leave them alone," said the exodontist. "They are the finest looking pulpless teeth that I have ever seen." Four other exodontists and one physician gave the same verdict.

The patient next visited one of the best diagnosticians in the city for a complete physical examination. The physician found no organic disturbances, indeed nothing to account for the patient's ill health unless it might be the three pulpless teeth. He prescribed sedatives and heat treatments and advised the removal of the pulpless teeth in case the prescribed treatments failed to bring relief.

No improvement whatever resulted from the treatments and the patient finally had the pulpless teeth removed. In about a month, he was in a normal state of health. All pain had disappeared; his appetite improved greatly; he slept soundly and felt refreshed upon rising; no more pains were felt in the heart; he no longer became tired, no matter how strenuous his labors, and he was no longer conscious of his left side—it seemed to be a perfect match for the right side.

All this happened eight years ago, and there has been no recurrence of any of the symptoms.

The foregoing case history is of especial interest to me because I am the patient referred to. What surprises me is the fact that four exodontists and one physician found nothing wrong with my teeth. They depended solely on x-ray evidence, asking no questions about my physical condition. The moment I find a pulpless tooth, I ply the patient with questions to determine whether he has any systemic disturbances which might be caused by, or at least aggravated by, pulpless teeth, and if there are such disturbances, I advise removal of the pulpless teeth even though the roentgenograms prove negative.

I am convinced that far too many men in the profession do not use sound judgment in dealing with pulpless teeth. To use such teeth for bridge abutments, as some of our best trained men still do, is a questionable procedure.

A perusal of current dental journals seems to point to an increasing tendency among dentists to rely too much upon x-ray evidence and not enough upon interrogatory, digital and ocular evidence. That roentgenograms are anything but reliable has been demon-

strated more than once. They should be used merely as an aid to a more comprehensive diagnosis. When I was young in the profession, I once asked an exodontist to examine a roentgenogram and tell me whether in his opinion a certain pulpless tooth should be retained or extracted. This doctor had spent two years at the Mayo Clinic and had acquired a scientific approach to dental problems. He scarcely looked at the roentgenogram, but with a knowing little chuckle replied, "I do not pretend to be able to see with the naked eye what it takes a powerful microscope to see." It was his opinion that a pulpless tooth is always infected and that a microscopic examination would prove the point.

To what extent he was right, it is not for me to say, but I do believe that whenever a roentgenogram shows pulpless teeth, we should not rely too much upon this evidence, but should let the patient's health determine whether we retain or extract the teeth.

My own experience was for me a most valuable lesson. I have become suspicious of all pulpless teeth. Once we have been burned, we shun fire.

1001 Medical Arts Building.

THE PROXIMAL GOLD FOIL FILLING

By R. O. GREEN,* D.D.S., and W. J. SIMON,† D.D.S., Minneapolis, Minn.

WHERE does gold foil fit into the present-day practice of dentistry? Why do some members of the dental profession advocate its use and others ignore it entirely? The attempt to answer these questions immediately brings up the problem of diagnosis, which is based upon the personal opinion of the operator rather than upon the critical advantages or disadvantages of gold foil in meeting the requirements of operative dentistry.

Perusal of the history of dentistry and examination of many case histories enlightens one as to what gold foil has contributed to the progress and development of the profession. It would be regrettable indeed to be limited in one's ability to dispense a professional obligation because of an inability to perform a gold foil operation, or because it is easier to select a substitute. . The material to be presented in this treatise may be regarded as an outline which has the purpose of portraying gold foil manipulation as a systematically organized, step-by-step procedure. Occasionally, variations and compromises will be necessary, but the principles to be outlined are basic. This technic, which is but one of many technics taught by the Division of Operative Dentistry of the University of Minnesota, has been correlated with the fundamentals of tooth morphology so that the operator may restore lost tooth structure quickly and cause as little discomfort to the patient as possible.

PRINCIPLES OF OUTLINE FORM AND VARIATIONS

For exemplary purposes, a small proximal cavity on an upper central incisor has been selected. (Fig. 1, A.) Before any instrument touches the tooth, the operator must determine an outline form which will promise an esthetic result.

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†Assistant professor of operative dentistry, University of Minnesota, School of Dentistry.

Fundamentally, the labial outline should be as nearly parallel to the long axis of the tooth as possible. (Fig. 1, B.) It is often preferable to make a slight display of gold rather than a thin line of gold, which will frequently appear dark under artificial light.

One of the more common errors in gold foil work is the lack of extension incisally through the contact point. Even with adequate separation, it is very difficult to fill a cavity so abbreviated. (Fig. 2, A.)

Overextension of the cavity at the labiogingival angle has an unesthetic result. (Fig. 2, B.) The access necessary in this area should be obtained through separation and not by extension of the labial margin.

VARIATIONS OF LABIAL OUTLINES

Tooth form may complicate the labial outline. Figure 3 illustrates the manner in which the square, ovoid and tapering types of teeth are treated.

In the square tooth (A) with the long broad contact, it is not always possible to maintain a labial margin parallel with the long axis of the tooth, as the incisal portion of the tooth is liable to become undermined and weakened. In the ovoid tooth (B), the cavity preparation is comparatively simple. Extension is carried gingivally and incisally only as far as is convenient for filling. In the tapering tooth (C), the cavity frequently will involve the proximal incisal angle. If sufficient separation can be obtained, it is not impossible to prepare a proximal filling.

IRREGULAR TEETH

A condition in which a central incisor overlaps a lateral incisor or a lateral incisor overlaps a central incisor, as illustrated in Figure 4, necessitates special consideration of outlines.

The axiom in treating this condition is that the tooth to which there is the least access on the lingual aspect should be filled first. The labial outline form on the adjacent tooth again should be parallel to the long axis of the tooth.

LINGUAL OUTLINE

Determination of the lingual outline before the removal of the caries is not possible. Figure 5 illustrates the vari-

A COMPARATIVE HEAT ANALYSIS OF THE GAS AND ELECTRIC GOLD FOIL ANNEALERS*

Heating Time in Minutes	Fahrenheit Temperature Readings					
	Test I Infirmary Unit C-11		Test II Infirmary Unit C-15		Test III Junior Laboratory Bench No. 92	
	Gas	Electric	Gas	Electric	Gas	Electric
1	†	†	†	†	†	†
2	225°	225°	100°	175°	250°	225°
3	275°	350°	175°	275°	350°	350°
4	300°	425°	225°	350°	400°	425°
5	300°	450°	250°	375°	375°	450°
6	300°	500°	275°	450°	400°	500°
7	300°	550°	225°	450°	400°	525°
8	300°	550°	250°	575°	375°	550°
9	300°	600°	275°	550°	400°	575°
10	300°	575°	250°	600°	400°	600°

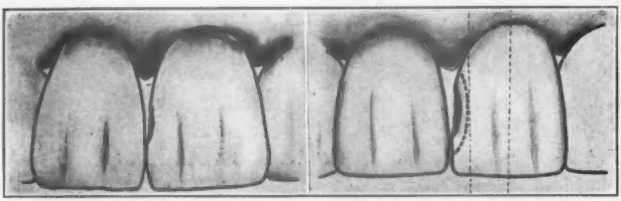
*By Charles E. Larson. (Analysis made February 4, 1941, by means of thermocouple.)
†Increments less than 70° are not in the pyrometer scale.

ance of extension of the lingual margin.

The linqual margin should always be cut away from contact with the approximating tooth. However, the extent of the caries may require excessive extension on the lingual aspect and in no instance should unsupported enamel be left in position.

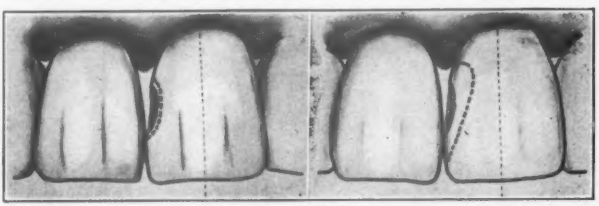
that the lingual wall is parallel with the cleavage lines of the enamel rods.

With a predetermined fundamental outline form in mind, the operator is ready to approach the cavity with instruments. The rubber dam is applied and the mechanical separator is adjusted. Slow separation prior to cavity prepara-



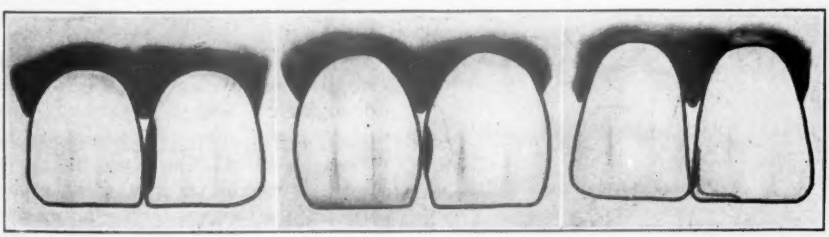
A B

Fig. 1.—A: Small proximal cavity on mesial aspect of upper left central incisor. B: Labial outline, which should be as nearly parallel to long axis of tooth as possible.



A B

Fig. 2.—A: One of more common errors in gold foil work, lack of extension incisally through contact point. B: Overextension of cavity at labiogingival angle, giving unesthetic result.



A B C

Fig. 3.—Tooth form complicating labial outline. A: Square tooth. B: Ovoid tooth. C: Tapering tooth.

Figure 6 illustrates a cross-section of a central incisor. If the caries is slight, the lingual margin should be extended to point B. If the caries is excessive under the marginal ridge, the lingual margin should be extended to point C so

tion and filling is considered a safer procedure at the University of Minnesota School of Dentistry.

Access to the case with a small area of decay located gingivally from the contact point can be obtained with a 48

chisel. (Fig. 7, A.) With this chisel, the enamel is chipped away in small pieces, the operator working from the surface toward the cavity until the labial margin is cut back to sound dentin.

With a No. 34 (Fig. 7, B.) inverted cone bur or a round bur of the same size, the decay can be removed. The unsupported enamel can be removed with chisels to the predetermined outline form.

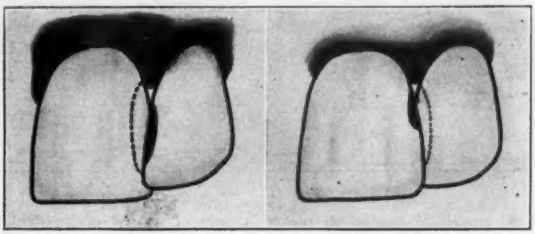


Fig. 4.—Irregular teeth complicating labial outline form.

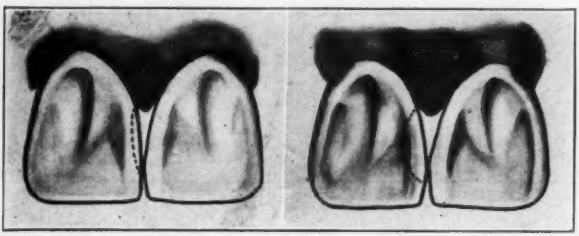


Fig. 5.—Tooth forms showing impossibility of determining lingual outline form before removal of caries.

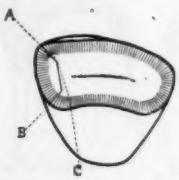


Fig. 6.—Extension of lingual margin so that lingual wall is parallel with the cleavage lines of the enamel rods in extensive caries under marginal ridge.

RETENTIVE RESISTANCE FORM

Figure 8 shows the steps in preparation of a retentive resistance form at the gingival wall, from a proximal aspect.

The linguogingival and the labiogingival angles should be extended sufficiently to free contact with the adjacent tooth. (Fig. 8, A.) The gingival wall should be flat in a mesiodistal direction and should be cut either flat labiolingually or be made to follow the curvature of the cervical line.

As illustrated in Figure 8, B, the inverted cone leaves a line angle at the linguogingival and labiogingival cavosurface angles. These line angles may be removed with a chisel (preferably the Wedelstaedt), this completing the outline form in the linguogingival and labiogingival areas.

The gingivo-axial line angle should be very definite at the junction of the gingival and axial walls. (Fig. 8, C.) The labio-axial and the linguo-axial line angles must be emphasized also. This is accomplished as illustrated with small right and left mon-angle hoes.

The purpose in accentuating the line angles (Fig. 8, D.) is to form definitely

the labio-gingivo-axial and the linguo-gingivo-axial point angles, which, in turn, are to be direction finders for the 000 round bur retention form.

RETENTION FORM

The retention form of a proximal gold foil cavity is actually an accentuation of line angles in areas considered able to resist not only the stresses of mastication, but also the stresses exerted within the tooth in the filling operation.

Figure 9, a labial aspect, shows the approach of a No. 000 round bur to three areas. Access is not always so easy as illustrated. Additional access, if needed, can be obtained by further extension of the lingual margin or by carefully increased separation.

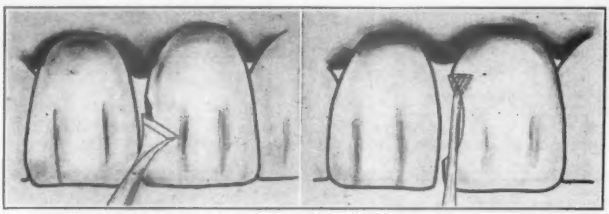
The direction of the gingival retention forms are such that they bisect the point angles. (Fig. 10.) Figure 10, A shows the correct direction; B, the incorrect. The bur is at all times to be in dentin half way between the pulp and the dentino-enamel junction. The depth to which this bur is projected is a matter of judgment, depending on the size of the cavity and the stresses to be exerted on the filling.

The labio-gingivo-axial and the linguo-gingivo-axial retention points should now be widened to allow for sufficient bulk of gold foil for retention. This is accomplished by means of the right and left mon-angle hoes. (Fig. 11, A.)

From the proximal aspect, in this procedure (Fig. 11, B), the retention point is shown taking on the outline of a funnel, which is more receptive for gold foil, as well as retentive.

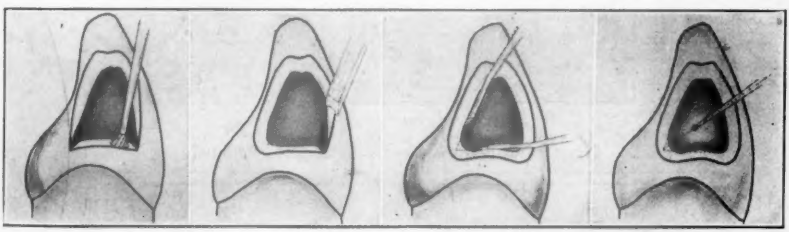
The labio-incisal retention form is not always so easily blocked out as is illustrated in Figure 9. The outline form of this cavity as presented permits the use of a bur as a direction finder for the labio-incisal retention form. However, the greater portion of its preparation is by hand instruments.

If it is not possible to gain access to the labio-incisal retention area with a



A B

Fig. 7.—A: Access obtained with chisel. B: Decay removed with bur.



A B C D

Fig. 8.—Steps in preparation of retentive resistance form at gingival wall.

ooo round bur, a 33½ inverted cone bur can be used, simply to block out the dentin. (Fig. 12, A.)

The labio-incisal point angle (Fig. 12, B) is created by scraping out the dentin until it is sufficiently deepened with a right angle hoe. Care should be taken to avoid cutting this retention form so close to the labial enamel plate as to weaken it. By placing the blade of the hoe in this angle and by a sweeping rotary motion, it is possible to enlarge further and deepen this point angle in a labial and incisal direction until it is retentive in form and large enough to receive the plugger point.

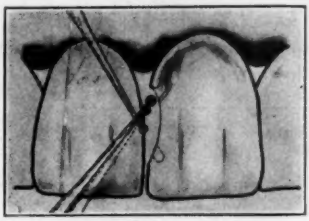
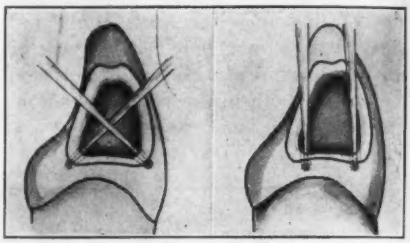


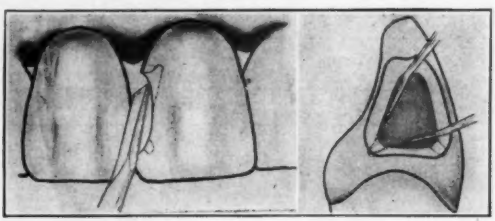
Fig. 9.—Approach for retention forms.

The purpose of placing the labio-incisal retention form in dentin between the pulp and the labial plate of enamel is diagrammatically illustrated in Figure 13. The stress placed on the upper proximal gold foil filling is normally in the lingual direction; therefore, the stress-receiving form is placed beneath the labial plate of enamel in dentin. Also, histologic studies reveal that the labial and the lingual enamel plates are not supported with a great bulk of dentin at the incisal edge; therefore, an incisal



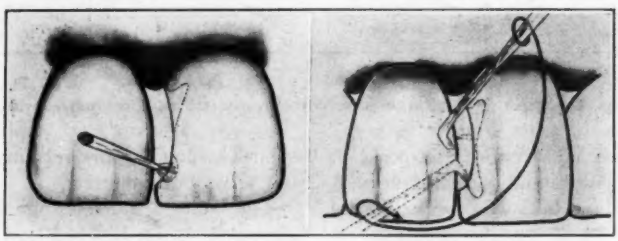
A B

Fig. 10.—A: Correct direction of retention forms. B: Incorrect direction of retention forms.



A B

Fig. 11.—Retention form with outline of funnel.



A B

Fig. 12.—Development of incisal retention form.

retention form may be undermining more enamel than the labio-incisal retention form.

FINISHING OF THE ENAMEL WALL

In Figure 14, A, the gingivocavosurface angle is being beveled with a mon-angle hoe. In Figure 14, B, the labial and lingual margins are being planed and smoothed, following the lines of cleavage of the rods. The angles joining the labial and lingual walls at the incisal portion must be beveled full width strongly toward the incisal aspect, this effecting a double bevel, which, in filling, affords easy access to this portion of the cavity.

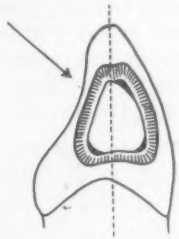
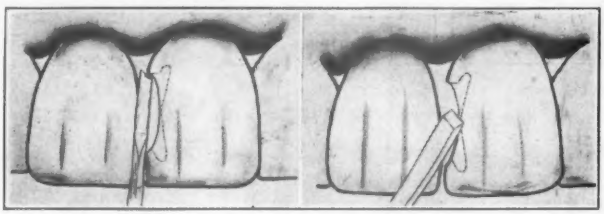


Fig. 13.—Stress placed upon upper proximal filling, normally in lingual direction.

The completed, cleansed cavity is presented in Figure 15, from various aspects, in recapitulation of some of the fundamentals of gold foil cavity preparation.

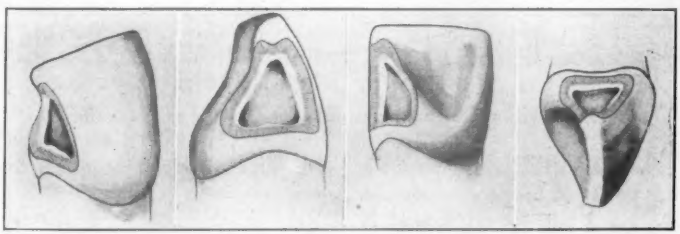
A proximolabial aspect shows the linguo-gingivo-axial retention form properly prepared, allowing for sufficient bulk of gold foil in this area. (Fig. 15, A.) For convenience in starting the gold foil, this retention form can be further accentuated with a No. 33½ inverted cone bur.

A proximal aspect shows the correct position of the incisal retention form to avoid undermining the incisal angle of enamel and inviting fracture of this portion. (Fig. 15, B.) The bevel of the gingivocavosurface angle is to be noted.



A B

Fig. 14.—Finishing of enamel walls.



A B C D

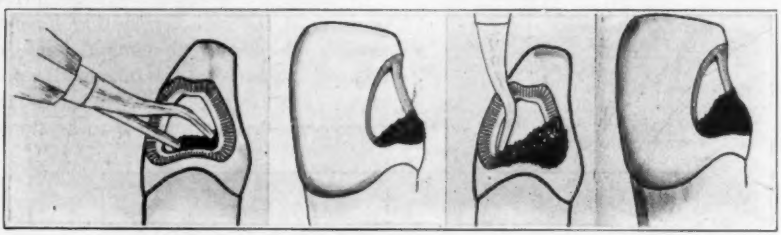
Fig. 15.—Four aspects of finished cavity.

In Figure 15, C, is illustrated a proximolingual aspect, showing the axial wall slightly convex and thus protecting the pulp; also the labio-axial line angle definitely acute without undermining the labial enamel plate, and thus making the

proper wedging of gold foil possible without fracture.

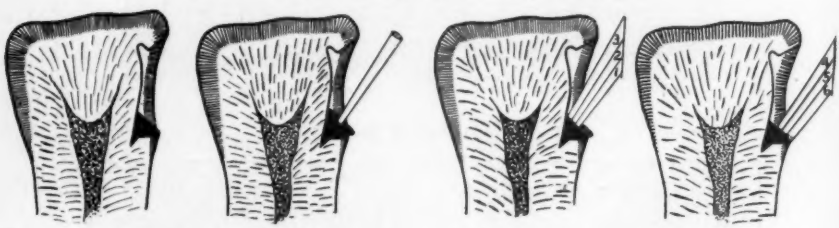
Figure 15, D illustrates a proximo-incisal aspect, showing the double beveling of the lingual wall and the labial wall at the incisal angle, and also showing the gingivo-axial line angle correctly made at right angles to the axial wall. It is not always expedient to prepare a double bevel at the incisal aspect.

The cavity is cleansed with hydrogen peroxide followed by chloroform and is now ready for filling with cohesive gold foil. A fibrous cohesive gold foil from any manufacturer who will guarantee the absolute purity of his product should be selected. The ½ size, loosely wound, is a very convenient pellet for general purposes.



A B C D

Fig. 16.—Steps in filling of gingival retention forms.



A B C D

Fig. 17.—Foil condensed at average of 45° to long axis of tooth.

ANNEALING OF GOLD FOIL

Gold foil, when absolutely pure, is inherently cohesive. Annealing is a procedure of heating gold foil long enough at a given temperature to volatilize all atmospheric moisture that may have settled upon it, thus keeping the gold cohesive.

At the University of Minnesota, School of Dentistry, annealing in bulk is the favored method. On the basis of the research presented in the accompanying table, the electric annealer has been selected because of the greater uniformity of heat that it insures.

A convenient method of keeping gold foil is constant exposure to the fumes of ammonia gas, which protects it from contamination by other gases. Ammonia gas renders gold foil non-cohesive. However, annealing will restore its cohesiveness.

MANIPULATION OF GOLD FOIL

In applying cohesive gold foil to a cavity, the force required for welding and condensation is exerted by means of hand pressure and the hand mallet or the electropneumatic condenser. To condense gold foil properly, the force should be in as nearly a direct line as possible to the long axis of the tooth so that the

peridental membrane may resist the pressure demanded in filling. The plugger points should be cleansed frequently and the serrations freed of gold adhesions. The amount of force applied in condensing gold foil will be governed not only by the surface area of the plugger points, but also by the tolerance of the patient. In the cavity preparation herein described, the approach is from the labial aspect for the condensers also.

The first two or three pieces of gold foil (Fig. 16, A) are folded into the linguo-gingivo-axial retention form by means of a very small round plugger point mounted in a cone socker handle and condensed by hand pressure with a small round plugger point in the electro-

Fig. 18.—Foil wedged between labial and lingual walls.

pneumatic condenser. Thereafter, the gold foil is built to contour along the linguo-axial and gingivo-axial line angles to the labio-gingivo-axial retention form by means of the same small round plugger point in the electropneumatic condenser. (Fig. 16, B.)

The labio-gingivo-axial retention form is filled by means of the same small round plugger point. (Fig. 16, C.) The gingival wall is completely covered, and the lingual wall built out to contour in advance of the labial wall because of the convenient labial approach. (Fig. 16, D.)

If the tooth filled thus far were sectioned along the long axis, the labial aspect would appear as A in the illustrations in Figure 17.

It will be noted in Figure 17, A, that the gold foil in the cavity has been condensed at an average angle of 45° to the long axis of the tooth. However, this should be accomplished by a definite plan of stepping the plugger point on each new piece of gold foil.

As each new pellet of gold foil is added (Fig. 17, B), the first blow delivered should be as nearly at the center of the mass of previously condensed gold foil as possible and stepped toward one of the walls.

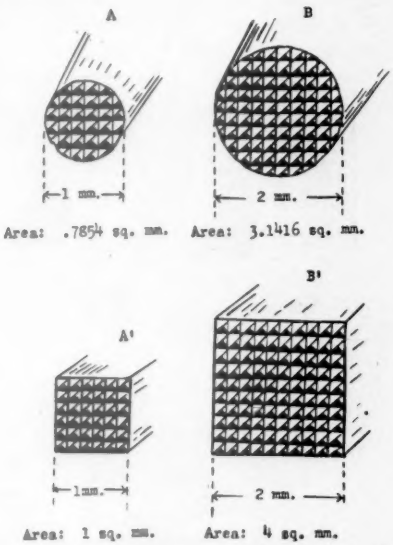


Fig. 19.—Variation of force required, inversely with square of area of plugger point.

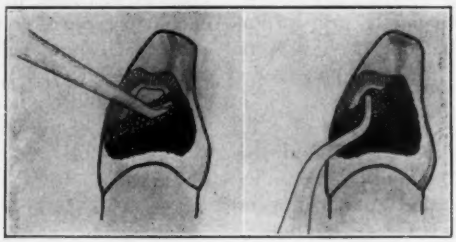
In Figure 17, C, the stepping is in a 1, 2, 3 order toward the axial wall.

In Figure 17, D, the stepping is in positions 4, 5, 6 toward the gingival wall.

After the two gingival retention forms have been filled with condensed gold foil, it is often more expedient to change from a small round plugger point to the rectangular foot plugger point.

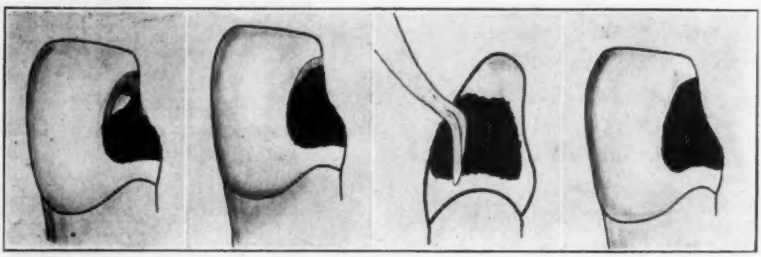
Regardless of the type of plugger point, the gold foil is being wedged continually between the labial wall and the lingual wall with the lingual wall slightly in advance of the labial wall. (Fig. 18.) At the same time, regardless of the type of plugger point, the gold foil should be stepped continually from the center of the mass of previously condensed gold foil toward one of the walls.

In changing from a small round plugger point to the rectangular foot plugger point, the surface area is increased; consequently, the force must be increased proportionally to weld and condense the gold foil to the specific gravity attained with a small round plugger point. The physical relationship between area and pressure has been reduced mathematically in Figure 19.



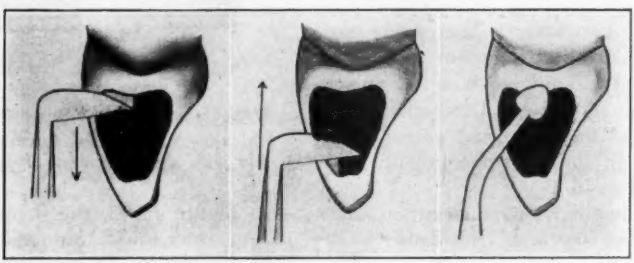
A B

Fig. 20.—Filling of incisal retention form.



A B C D

Fig. 21.—Steps in completion of filling.



A B C

Fig. 22.—Finishing gingival area.

Hypothesis: The force required to condense gold foil of uniform weight

and volume varies inversely with the square of the area of the plugger point.

Result: The force required to condense gold foil of uniform weight and volume with plugger points B or B must be increased four-fold in order to produce a specific gravity comparable to that obtained by condensing the same gold foil with plugger points A or A respectively. This is a factor which must be correlated to assure uniform condensation. (Fig. 20, A.)

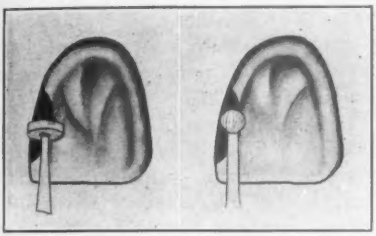
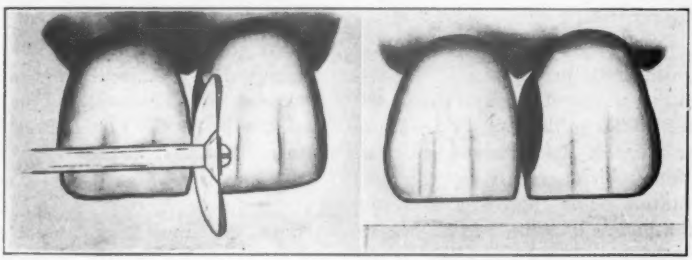


Fig. 23.—Finishing gingival area.

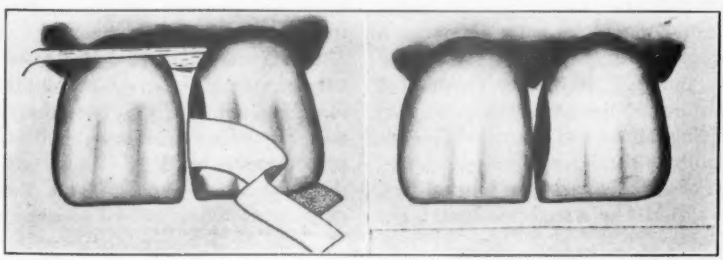
With the foot plugger point mounted in the electropneumatic condenser, the gold foil is built up to the contact point. (Fig. 20, B.) The point is held as nearly parallel as possible to the long axis of the tooth to secure the best possible condensation about the contact area. When the gold foil has been condensed to the labio-incisal retention form, it is again necessary to change from the foot plugger point to the small round off-set plugger point in order to condense the gold foil incisally in the retention form and line angles.

After condensation of the gold foil into the labio-incisal retention form, the foot plugger point is again mounted in the electropneumatic condenser and the cavity is completely filled. In using the foot plugger at the cavo-angles, care should be exercised to condense to the margins before condensing over the margin. (Fig. 21, B.)



A B

Fig. 24.—Finishing labial area.



A B

Fig. 25.—Finishing contact area.

In using a foot plugger point, it is judicious to use one piece of gold foil at a time. However, if a small round plugger point is used, two pieces of foil can be handled very nicely without the probability of poor condensation, provided the stepping technic is always used.

After-condensation is obtained by some operators by means of hand burnishers. Figure 21, C shows a type of after-condensation using a large parallelogram, which is expedient because, by means of the toe of this parallelogram, it is possible to after-condense well into the interproximal space gingivally from the contact area. Figure 21, D is a proximo-labial illustration of the condensed gold foil filling ready for finishing.

FINISHING THE PROXIMAL GOLD FOIL RESTORATION

In finishing the proximal gold foil restoration, it is essential to recover the original esthetic outline created. There are four areas of the proximal gold foil restoration which require specific instrumentation. The gingival area of the foil is finished as illustrated in Figure 22.

The gold trimming knife (Fig. 22, A) can be used in the conventional manner. If the back of the blade is cut at right angles to the long axis, the gold trimming knife can be used in back action as a scraper. (Fig. 22, B.) Gold foil files of all sizes and styles have been created for the finishing of this area. (Fig. 22, C.)

The lingual area of the gold foil restoration can be grossly recovered by means of small carborundum stones. (Fig. 23, A.) The actual polishing is obtained by means of plug finishing burs and abrasives. (Fig. 23, B.)

The labial area of the gold foil restoration can be finished and contoured by means of flexible garnet and cuttle disks. (Fig. 24, A.) However, the disk is not flexible enough to finish the entire filling. An attempt to use the disk alone results in an unesthetic, poorly contoured restoration, which is apt to result in pathologic conditions of the investing tissues. (Fig. 24, B.)

The contact area of the gold foil restoration is finished by means of garnet and cuttle strips, which are drawn through the interproximal space after the positioning of a separator. By changing the tension on these strips, clever operators can fully contour fillings. (Fig. 25, A.) Usually, the cuttle strip will polish the gold foil sufficiently. However, if a high polish is desired, pumice, whiting, silex and tin oxide conveyed on a rubber cup can be used. The finished restoration is illustrated in Figure 25, B.

SUMMARY

The ever-increasing importance of operative dentistry has brought to the profession a new realization of the emphasis that must be placed upon systematically planned methods of operating and the fact that what once seemed difficult, seen in a new order, becomes very simple. The use of gold foil demands qualities of concentration, exactness, precision, cleanliness, patience and perseverance, but it gives to the operator the real joy of having placed the most permanent filling known to dentistry.

FURTHER STUDIES ON METHODS OF REMOVING BROWN STAIN FROM MOTTLED TEETH

By H. V. Smith,* M.S., and John W. McInnes, D.D.S., Tucson, Ariz.

DURING the studies on preparation of bone for use in filters, to remove fluorine from drinking water at the University of Arizona, bleaching agents such as sodium hypochlorite and superoxol were used to destroy the organic matter in the bone.[1] The similarity in composition between teeth and bones suggested the use of these agents as a possible means of removing the brown stain from mottled teeth. It was not until Dr. McInnes, who had formerly practiced in Texas and who was familiar with the report of members of the Texas Dental Association[2, 3, 4] and the work of Ames,[5] began practice in Tucson that it was tried in an experimental way at the University of Arizona.

These experiments were conducted both in the laboratory, on extracted teeth, and in the dental chair, on human subjects.

In the past, it has been a common practice to remove the stain by removing the enamel. This has been done either by grinding or by dissolving with an acid. There are several stain removers on the market, the active constituent of which is hydrochloric acid. Two of these have been tested in the laboratory. For purposes of identification, they will be called T and E. These preparations were titrated with a standard base and were found to have a hydrochloric acid equivalent of 4.67 and 3.47 per cent, respectively.

Table 1.—Loss of Tooth Enamel After Immersion in Stain Removers

Tooth No.	Weight with Paraffin	Treatment	Weight After 15 Minutes Immersion	Loss Gm.	Loss* Per Cent
1	1.4102	20 ml. "T"	1.1140	0.2962	26.60
2	1.1705	20 ml. "E"	1.1039	0.0666	6.03
3	2.1828	20 ml. "T"	1.7359	0.4470	23.70
4	2.2228	20 ml. "E"	2.1102	0.1126	5.31
5	1.1295	20 ml. "T"	0.8529	0.2766	32.40
6	1.0289	20 ml. "E"	0.9811	0.0478	4.87

*These losses were calculated on the weight of the entire tooth, the root of which had been paraffined. The losses are lower than if calculated only on the basis of the crown.

These products were tested in several different ways. In one case, the roots of the teeth were coated with paraffin and the entire tooth immersed in a beaker containing 20 ml. of either of the two solutions. The loss of enamel after fifteen minutes' immersion is shown in Table 1.

The losses occasioned by T were so great that further studies were conducted using shorter periods of immersion. A tooth having a moderately severe type of mottling of the enamel, with deep stain-

*Associate agricultural chemist, University of Arizona.

ing, was immersed (crown deep) in T for one minute at intervals. Figure 1 shows graphically the loss from this tooth.

a stain remover, and also confirms the work of Trask *et al.*[6]

A third trial was made by using T diluted to 1 per cent hydrochloric acid

TABLE 2.—LOSS OF TOOTH ENAMEL AFTER IMMERSION IN DILUTED T

Tooth No.	Time in Minutes		Original Weight Gm.	Final Weight Gm.	Loss Gm.	Loss Per Cent
	Treatment 1% T in Water*	Treatment 1% T in 30% H_2O_2†				
1	2		0.6030	0.5945	0.0085	1.41
2		2	1.1735	1.1624	0.0111	0.94
3	4		0.7592	0.7459	0.0133	1.75
4		4	1.1994	1.1859	0.0135	1.13
5	6		0.6692	0.6542	0.0150	2.24
6		6	1.0113	0.9944	0.0169	1.56
7	10		0.5832	0.5620	0.0212	3.63
8		10	2.3530	2.3183	0.0347	1.05
9	20		0.5055	0.4720	0.0335	6.63
10		20	0.8662	0.8278	0.0384	4.43

*pH 0.81
†pH 0.80

TABLE 3.—RECORD OF BLEACHING MOTTLED TEETH

Subject	Fluorine Content of Water Used	Original Severity of Stain	Enamel Condition	Bleaching to Date, Per Cent	Hours Treated
A	5.0	Severe	Hard, brittle	100	22
B	5.0	Moderately severe	Sound	100	8¾
C	3.6	Severe	Sound	100	16
D	2.0	Mild	Very sound	100	2
E	3.0	Moderately severe	Sound	100	3¾
F	3.0	Severe	Sound	100	11½
G	4.5	Severe	Sound	90	8
H	3.0	Severe	Badly pitted and chalky	67	7½
I	6.0	Very severe	Soft and pitted	33	4½
J	6.0	Very severe	Soft and chalky	33	3½
K	2.0	Mild	Sound	25	2
L	1.5	Moderate	Sound		6½
M	1.2	Mild	Sound	20	1
N		Moderately severe	Sound	25	2¾

The enamel seemed to be impregnated with stain almost to the dentin and it was necessary to remove all of the enamel in removing the stain. The size of the crown was materially reduced. This shows the danger of using acids as

equivalent with water and with superoxol. The losses with these more dilute solutions were appreciably less (Table 2) than when stronger solutions were used.

In each case, the percentage loss was

greater when T was diluted with water than when it was diluted with superoxol. It should be noted that the tooth treated with T plus peroxide was originally heavier than the other tooth. Because these teeth were not stained, it was possible to measure only enamel losses.

The fourth attempt to measure enamel losses was made by measuring a tooth with a micrometer caliper before and after immersing the tooth in T for various time intervals to note the loss of enamel from the crown. Figure 2 shows these losses to be appreciable when the tooth has been immersed for even a short time in T. Immersion for fifty-four minutes caused a loss of more than 20 per cent in cross-section of the crown.

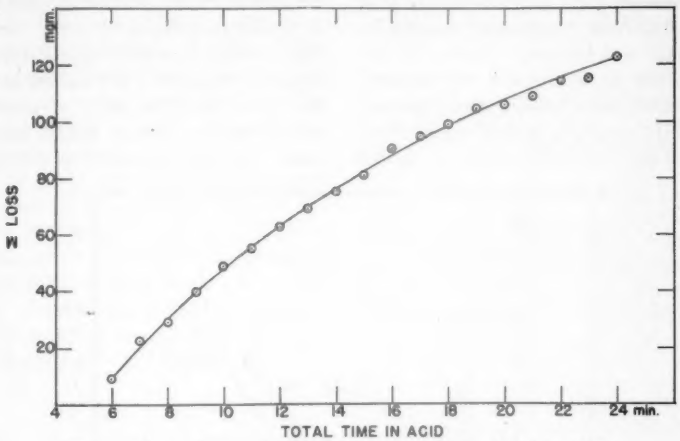


Fig. 1.—Loss of enamel when extracted tooth is placed in "T."

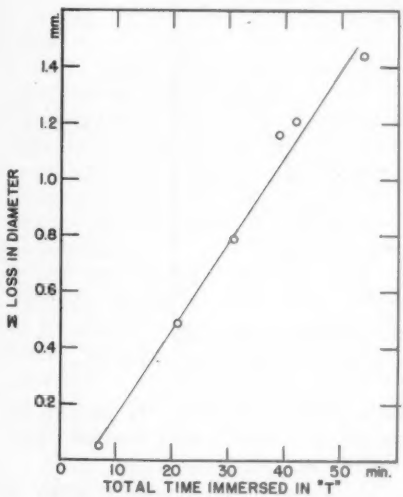


Fig. 2.—Decrease in diameter when extracted tooth is placed in "T."

One person who had used T to remove the stain from mottled teeth gave the following suggestion after his experience: In using this preparation, care must be taken not to use too often or too much at a time. Best results can be obtained by simply rubbing a small quantity on the teeth, allowing it to stay on the teeth for a minute or so and then cleaning it off with some dentifrice. It should not be used oftener than once or twice a week since the substance is quick acting and very penetrating.

This statement should be sufficient warning against the use of such preparations.

THE USE OF BLEACHING AGENTS

Several students in residence at the University of Arizona offered themselves as subjects for experimental removal of the stain. Other cases have been treated

professionally by one of us (J. W. M.). Of the oxidizing agents tried in the laboratory, only hypochlorite and peroxide were used on human subjects, because they showed the greatest promise. The treatment used was essentially that outlined by Ames[3] and used locally by Drs. Gillard and Hiesser.

The teeth to be treated are isolated with a rubber dam (if necessary, ligatures are placed) and are bathed with ether. A cotton roll or loose cotton is ligated against the teeth. The upper gingivae and lips are protected by a gauze under the dam. The mixture of 5 ml. of superoxol and 1 ml. of ether is then used to saturate the cotton. Heat is applied by the patient according to his particular tolerance. A modified soldering iron (Fig. 3) with a metal piece to fit the upper four or six anterior teeth makes a suitable heating unit. A rheostat placed in the line is used to control the heat. The iron is held in contact with the moistened cotton. Additional liquid is added from time to time to replace that lost by evaporation.

To minimize the discomfort, some of the patients were advised to take 5 grains of acetyl salicylic acid every two hours until bedtime, following treatment. In two cases in which this failed to control the pain satisfactorily, a prescription was given for codeine sulfate one-fourth grain, and phenobarbital one-half grain. Even with this narcotic, the patients reported considerable post-treatment pain until the next day.

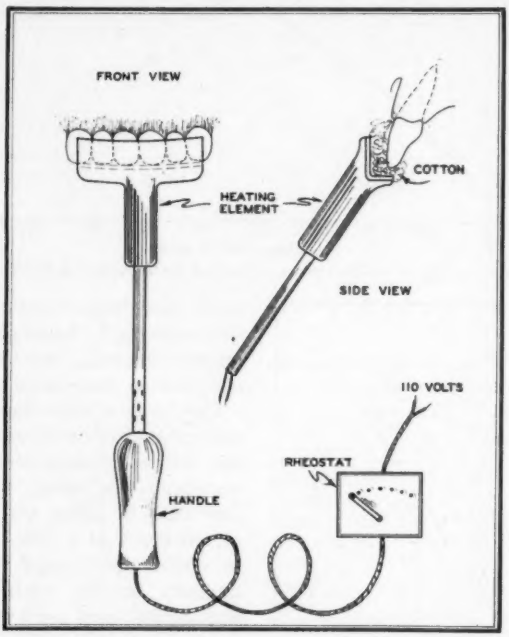


Fig. 3.—Apparatus for applying heat to teeth during bleaching treatments.

The patient was allowed to apply as much heat as he could comfortably stand. The treatment varied from thirty to sixty minutes. The exact length of time was determined by the patient.

After each treatment, when the cotton pack had been removed, the stain appeared to be no lighter than before that

particular treatment was begun, but, within a few hours, the bleaching effect was quite marked. Probably because of the use of the dam and ligatures, the application of heat and the possible action of the chemicals, the teeth became somewhat sensitive, so that daily treatments were considered inadvisable. Three treatments per week were satisfactory according to certain of the patients. Others preferred to have treatments at least a week apart.

In most cases, little pain is experienced by the patient during treatment. Considerable sensitivity is reported for several hours after treatment, in the nature of a reaction to cold water or to air. Various persons report quite a variation in the amount of discomfort. None of these experienced pain the day after treatment.

Bleaching of the enamel seems to be quite uniform. In many cases, the teeth present the unnatural paper-white appearance of newly erupted mottled teeth.

More than twenty cases have been satisfactorily treated to date. A few representative ones will be described to indicate in a general way the length of time required to bleach teeth which are disfigured with staining of different degrees. This information is summarized in Table 3.

The experimental patients will be identified by symbol only. The severity of the staining varied from mild to extreme. The degree of mottling, but not of staining, could usually be correlated with the concentration of fluorine in the drinking water.

REPORT OF CASES

Subject A, a boy 19 years of age, presented severe Class II malocclusion. His teeth had few cavities and very hard, vitreous enamel, which showed signs of chipping from pressure. Mottling was severe. The stain was so dark as to be almost black. The area chiefly affected was below the lip line of the upper anterior teeth. The patient was treated over a period of about six months. Most of the treatments were of one hour duration, at one week intervals. At present, about one year after completion of the case, no recurrence of the stain is reported. Although nearly all the mottling stain was removed, the dentin is exposed in places owing to the apparent chipping of the enamel, so that the color is not uniform.

In contrast to subject A is subject D, aged 25, whose teeth were only mildly stained and were in a sound condition. Two treatments of one hour each removed the stain very satisfactorily.

G, a woman 35 years of age, had a quite severe case, the teeth being chalky and darkly stained. The patient complained bitterly of the after-pain and, after eight hours, stopped the treatment because of it. Bleaching was estimated to be 90 per cent complete when the treatments were stopped.

H, a girl 12 years of age, had badly pitted teeth and deep stain. It was realized before treatment that the case would be difficult and that the result would not be satisfactory because of the pitted character of the teeth. The child grew to dread the treatment and at last almost refused to tolerate any heat on the teeth. The case was stopped by mutual agreement of the dentist and the parent after seven and one-half hours of treatment. It is pertinent to say that six months after the last treatment, the family seemed satisfied with the results of the partial treatment.

L, a woman 22 years of age, had a case of mild staining and sound enamel that responded very favorably to treatment. Six and one half hours of treatment left the teeth with quite good color.

Additional information concerning these and other cases will be found in Table 3.

More than a year has passed since some of these treatments were given. In every case, the teeth have resisted staining, although there is no reason to suppose that they will remain permanently free from stain. The condition that permitted the stain to penetrate the enamel remains. The teeth are still mottled and somewhat soft; hence, they may slowly absorb stain again. If staining should recur, one or two treatments should again remove the

stain unless the case was permitted to progress too far before treatment.

NATURE OF THE STAIN

Through the courtesy of Mr. A. J. Thompson, of the Mining College of the University of Arizona, qualitative spectroscopic analyses were made of several stained and unstained teeth. This examination revealed no qualitative difference in the composition of these teeth; which strengthens our original contention that the stain might be of organic origin. Two points of evidence strengthen this theory: (1) the spectroscope does not detect the presence of organic compounds, and (2) the stain is removed by acids only when the enamel is removed, but is removed by superoxol without destruction of the enamel. No attempt has been made to determine the composition of the stain.

Superoxol, or 30 per cent hydrogen peroxide, decomposes very readily into $2H_2O$ and O_2 unless stabilized in some way. Merk's Index, 1930, page 510, shows the presence of the following acids in superoxol which tend to stabilize it.

	Per Cent
Free acids	0.001
Sulfuric acid (SO_3)	0.015
Oxalic acid $H_2C_2O_4$	0.035
Hydrochloric acid	0.001
Hydrofluoric acid HF	0.005
Phosphoric acid	0.005

In order to determine specifically the agent responsible for bleaching, a mixture of acids of the strength listed above was prepared for use on teeth with a pH of 2.3. This solution proved definitely inferior to superoxol and ether in removing the stain from the teeth. Thus it appears that the oxidizing agent in the peroxide is the active factor in this mixture.

USE OF HYPOCHLORITES

If the stain is of organic origin, any strong oxidizing agent that will penetrate the enamel should destroy the compound and possibly render it colorless. Clorox both unaltered and mixed with ether was used in one case. Bleaching was appreciable, but slower than with superoxol. Toward the end, bleaching was so slow that the last traces of stain were removed with superoxol.

CONCLUSIONS

Corrosive acids should not be used to remove stain from teeth except where the stain is superficial. The acid should be applied and neutralized almost immediately if used at all.

Superoxol effectively removes the brown stain from mottled teeth if used in accordance with the instructions here given. Because of the necessity of applying heat during the treatment and the caustic nature of superoxol, the treatment should be given only by a dentist.

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RAPID TREATMENT IN CERTAIN TYPES OF MALOCCLUSION

By Bert G. Anderson, D.D.S., New Haven, Conn.

THE slow movement of teeth in the treatment of malocclusion has been advocated by orthodontists as a cardinal principle of practice. It has been believed that movement faster than what has been termed the "physiologic rate" is apt to cause (1) bone resorption, leading to loosening or loss of the teeth, (2) root resorption, (3) destruction of the dental pulp and (4) excessive pain. A review of the orthodontic literature impresses one with the fact that no one has seriously questioned the validity of the concept of a physiologic rate of movement, nor doubted that permanent injury to the teeth results when treatment deviates from this principle.

During recent years, patients with certain types of malocclusion have been selected at the New Haven Hospital Dental Clinic for experimental orthodontic treatment and observation, in order to attempt a simplified method of treatment, to test the principle of slow physiologic movement and to study the results of partial or regional treatment over short periods of time.

Since 1934, a group of twenty-four patients, fourteen boys and ten girls, have been selected for this investigation. All were white children and ranged from 8 to 15 years of age at the onset of the treatment. Only patients with one or more anterior maxillary teeth in lingual version (Figs. 1a, 2a, 3a, 4a, 5a and 6a) were selected for treatment. In most cases, the opposing mandibular incisors were more or less labially displaced, and, in some instances, the entire lower jaw was a half-cusp width or less in anterior relation to the upper jaw.

The patients were divided into two groups and two different technics of therapy were employed. In one group, consisting of nineteen patients, brass wire ligatures, 26 gage, were fixed to those teeth that were out of alinement. The wires were bent into staple-like forms and passed from the labial to the lingual side around the maxillary teeth, and from the lingual to the labial side around the opposing mandibular teeth. The two ends of each ligature were twisted tightly as the wire was drawn around the cervical portion of the tooth. These twisted wire ends on opposing maxillary and mandibular teeth were then united across the incisal edges in order to hold the jaws together and to form a sort of guide plane to prevent the teeth from assuming their former malocclusal relationships, while it also served to guide them toward normal occlusion. In cases wherein the ligatures tended to slip off the more peg-shaped mandibular incisors, two approximating teeth were tied together to serve as antagonists for one maxillary incisor. (Fig. 1b.) Similar ligatures were also placed on two opposing more bell-shaped bicuspids or molars on each side without crossing the bite, in order to prevent the patient from dislodging the anterior wires by tugging at them in attempting to open the mouth. (Fig. 1b.)

In the second group, consisting of

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five patients, bands with spurs instead of intermaxillary wires were employed to obtain movement of the teeth. This method was used chiefly where it was difficult to secure wire ligatures to the tooth crowns because of their peg shape or insufficient eruption. Figure 2a, b, c and d illustrates a case in which this appliance was placed on the mandibular incisors in order to bring the maxillary incisors into alinement. Bands with lingual spurs were constructed and cemented in place in such a manner as to guide the teeth to correct positions. The spur consisted of a piece of half-round wire, heavy enough to withstand the occlusal stress, which was soldered to the lingual portion of the band. This portion of the band was also reinforced considerably by allowing a quantity of solder to flow over the lingual surface. The spur was allowed to extend beyond the band and rest against the palatal aspect of the maxillary incisor. In order to support the weaker mandibular incisor, which otherwise would have had to bear the whole force of the bite against the maxillary incisor, a piece of bar metal was attached to the band on the labial surface and made to rest against the approximating teeth for anchorage. A band and spur of this type served as an inclined guide-plane. With this appliance, teeth were moved into alinement satisfactorily, while the patient had the advantage of a limited use of the jaw during treatment. By this method, however, the teeth were under less direct control for observation purposes, and movement in some cases was slowed considerably. This device was also employed for retention of corrected positions, owing to a shallow overbite. (Fig. 1d.)

In beginning treatment, patients were advised that they should expect some discomfort; that there would be no difficulty in furnishing them with a nutritionally adequate diet which could easily be taken into the mouth between the teeth, and that there would be only a slight speech impairment with the jaws fixed in position. The patients who were attending school continued with their classwork without much difficulty. During treatment, patients were required to visit the clinic four times the first week and three times the second week for inspection and to take up the slack in the wires or readjust the guide spurs. Thereafter, they returned for inspection and follow-up records once a week for a month and again after inter-

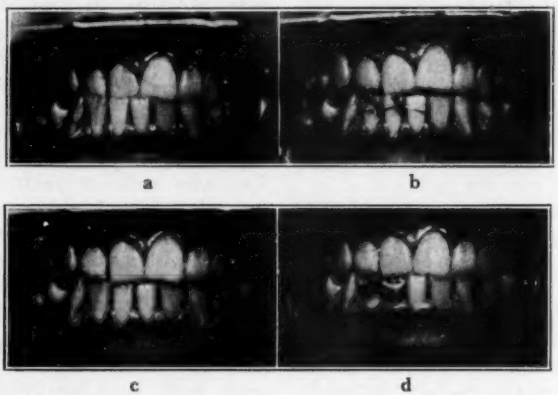

Fig. 1.—a, before treatment (11-13-34). b, treatment begun (11-13-34). c, treatment stopped (11-19-34). d, result one year later.

vals of six weeks, three months and six months. Although the experimental period was considered to be over after one year, some patients have been seen annually for five years.

Case 3 (Figs. 3a, b, c and d) is that of an 8-year-old girl with anterior maxillary teeth in lingual version. The mandible was about a half cusp width in anterior occlusion and slightly deviated to the left. There was a conspicuous deformity of the face and a marked speech defect (lisping). In this case, the incisal edges of the anterior mandibular teeth were biting against the labial gingivae of the maxillary incisors. (Fig. 3a.) The anterior wires were removed two days after treatment was begun. The posterior ones, which held the jaws in the corrected relationship, were removed five days later. Although the treatment was administered for one week, the correction continued during the ensuing months as the teeth settled into occlusion, as seen in Figure 3c and d.

Case 4 (Fig. 4a, b, c and d) is that of a 10-year-old boy whose permanent right maxillary incisor had erupted lingually to the two opposing teeth and partially behind the corresponding incisor on the left side. In this case, the treatment was applied for two weeks, after which the wires were all removed and the teeth allowed to follow their inclined planes. The result of the drift toward normal occlusion is seen in Figure 4d, after one year had elapsed.

Case 5 (Fig. 5a, b, c and d) is that of a boy 11 years old who applied for relief of pain and care of loosened anterior maxillary and mandibular teeth on the left side. Examination revealed considerable mobility and soreness of these teeth and periodontitis. The mechanical treatment of the case was carried out in nine days, after which the deciduous left maxillary cuspid was extracted in order to eliminate this malocclusion and make room for the succeeding permanent cuspid, which was erupting normally. The orthodontic treatment resulted in the elimination of the marked deformity and an immediate improvement of the associated periodontal disease.

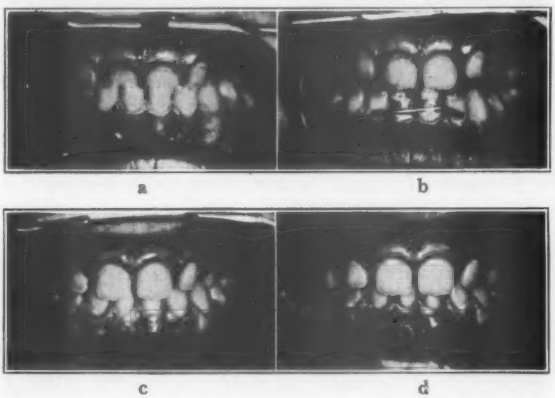

Fig. 2.—a, before treatment (6-7-38). b, treatment begun (6-7-38). c, result (9-6-38). d, result (12-5-38).

Case 6 (Fig. 6a, b, c and d) is that of a 10-year-old boy who applied for advice and treatment of the malocclusal deformity shown in Figure 6a. The two maxillary permanent first incisors and the deciduous cuspid on the right side were in lingual version. The three intermaxillary wires, seen in Figure 6b, were

put on the teeth March 17, 1934. These wires and the maxillary deciduous cuspid were removed March 21, 1934. The teeth were then allowed to shift for themselves. The result one year later is shown in Figure 6d.

The technic requiring the wire ligatures was employed in nineteen cases. In seven of these cases, the corrected position of the teeth was maintained by means of retaining bands with attached spurs. Three of the patients had more complicated malocclusion, which required orthodontic correction after the experimental treatment. Of the nineteen cases in which the wire ligature technic was used, two were treated in two days, two in three days, eight required a week and seven, two weeks or less. This treatment was sufficient to bring the teeth into such relationships that movement toward normal positions followed. In the five cases treated exclusively with the aid of the band-spur or guide-plane, the time required for the teeth to assume a correct relationship ranged from

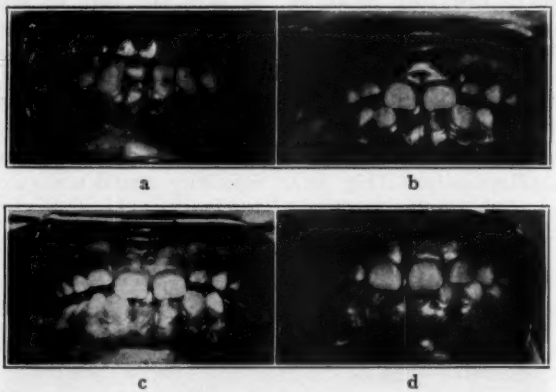

Fig. 3.—a, before treatment (5-19-34). b, after treatment for two days (5-21-34). c, treatment stopped (5-26-34). d, result one year later.

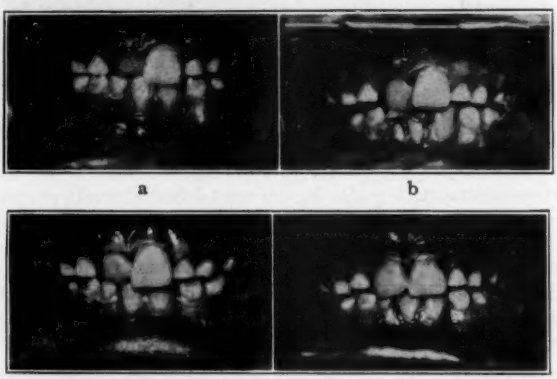

Fig. 4.—a, before treatment (4-16-34). b, treatment begun (4-16-34). c, treatment stopped (4-28-34). d, result one year later.

one to several weeks. In a number of instances, the improvement extended beyond the region treated and continued with the development of the dentition after the removal of the appliance.

The members of this group have been followed from one to five years in order to observe the development of the occlusion. In all the twenty-four patients subjected to treatment, there was marked correction of the malocclusal deformities. In one who was also suffering from severe periodontal disease, relief was obtained from this condition. No attempt was made to bring about the ideal mechanical occlusion which is commonly the goal of orthodontists.

Since the beginning of modern orthodontia, authorities in this field have stated that bone and tooth root resorption, pulp destruction and excessive pain will result if excessive force is employed in orthodontic treatment. By means of the minute pressure commonly used, it has been possible to move teeth only exceedingly slowly. This force is generally

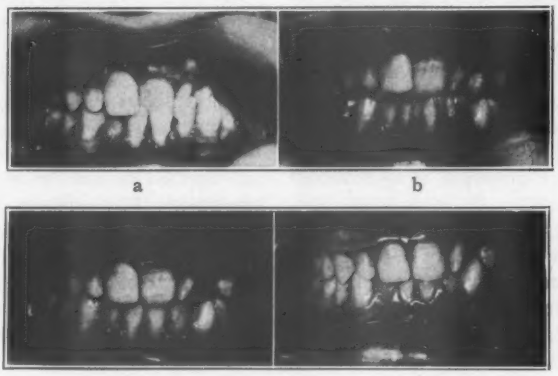

Fig. 5.—a, before treatment (2-8-34). b, treatment begun (2-8-34). c, treatment stopped (2-17-34). d, result one year later.

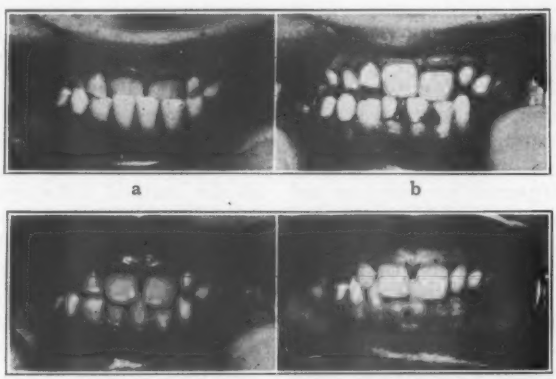

Fig. 6.—a, before treatment (3-17-34). b, treatment begun (3-17-34). c, treatment stopped (3-21-34). d, result one year later.

applied with the aid of rubber elastics or wire springs and consequently is fairly uniform and constant in action.

Although orthodontic appliances in common use are said to be physiologic in action, it is doubtful whether this term is correctly descriptive of a mechanism that is activated by elastics or springs. Rhythmic movement is a rule of nature. A force that is interrupted with recovery periods is certainly more physiologic in action than one that is constant. Interrupted pressure will increase the circulation, while uniform and constant pressure tends to depress or check it. This principle is well recognized in massage.

In the past, many orthodontists have advocated the practice of removing regulating appliances now and then, particularly during the summer months, in order to permit rest periods without active mechanical treatment. Constant pressure in terms of weeks, months or years interspersed with such rest periods, however, is not comparable to a pressure which is frequently applied and as frequently interrupted. The application of pressure must be followed by an interruption which occurs soon enough to permit relaxation or recovery; in other words, before permanent damage results. For instance, a muscle contracts and then relaxes to permit recovery; or one changes position during sleep, and thus renewal of circulation occurs in tissues which would otherwise be compressed too long with the body weight.

The presence of guiding wires or spurs on the teeth caused these patients to bite or nibble at them. Considerable force was applied, but the intermittent nibbling action apparently allowed for the necessary recovery of circulation in structures under the influence of a pressure that would otherwise not have been tolerated. This was the kind of force employed in the movement of the teeth in these cases.

No excessive pain was observed in these patients. All experienced a moderate degree of discomfort during the first day or two of treatment. There was, however, no more complaint of pain than is common during the initial stages of conservative orthodontic treatment. Although the jaws were bound together and movement of the teeth was brought about comparatively rapidly, at no time was stronger force exerted by the operator than when separation wires are applied in conservative orthodontic treatment. The wiring technic described here was not forcefully applied. There was sufficient irritation from the wires, however, to cause the patient himself to exert or make pressure on the teeth as he would, but not to the extent of overforcing them.

In no instance was a tooth "devitalized." Neither teeth nor surrounding bone evidenced resorption on follow-up x-ray examination, nor was any permanent loosening of teeth observed as the result of this treatment. As far as could be determined by clinical and x-ray examination, none of these patients suffered any permanent injury as a result of the treatment. On the other hand, all the occlusal deformities were either corrected or much improved.

This study indicates that (1) more rapid treatment of malocclusion is justified, at least in certain cases, (2) regional and short-period treatment may initiate corrective development which may continue after such treatment has been terminated and (3) an interrupted pressure which increases the circulation is probably more favorable for tooth movement than a constant one.

PREVENTION OF HISTOPATHOLOGIC CHANGES IN YOUNG DOGS' TEETH BY THE USE OF ZINC OXIDE AND EUGENOL

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INTRODUCTION

THE effect of operative procedures and of the use of various filling materials on the pulp has long been empirically discussed. There is some experimental evidence as to what does happen histologically in the tooth. However, there has been disagreement in the details of the findings of various research workers. This disagreement, along with incompleteness of the work, has prevented universal acceptance of the findings. Even so, there is no doubt that, at times, pulps are severely damaged either by the cutting of cavities or by the use of certain filling materials. Manley, and Gurley and Van Huysen, have indicated that this might be prevented or minimized by the use of zinc oxide and eugenol. It was therefore considered that the effect of these substances should be more intensively studied.

Gurley and Van Huysen[1] have reviewed the literature on the work done in this field by Fish, Palazzi, Fasoli, Kronfeld, Manley and Dolder. This review and other work of Gurley and Van Huysen[2] show that there is a tendency for histologic changes to occur under open cavities and with all types of filling materials, except zinc oxide and eugenol, when used in the teeth of animals. Dolder,[3] in experimental work on children with silicate cements placed in relatively shallow cavities directly on the cavity surfaces without the benefit of any protective agent between filling material and dentin, observed no damage to the pulp.

Pincus[4] believes that oxyphosphate of zinc cement linings should be placed in cavities as a protection to pulps. He also states that, in deep cavities, it is wise to place a little zinc oxide and eugenol over the area nearest the pulp. He is of the opinion that oxyphosphate of zinc cement causes dehydration of the dental tubules because it absorbs moisture on setting, and that this dehydration is a cause of pulpal irritation.

These studies indicate a need for an efficient protective material, both as a temporary filling and as a lining beneath present restorative materials.

PURPOSE

The purpose of this study was to compare the histologic appearance of the pulps of dogs' teeth in which cavities had been cut and left open with those similarly prepared, but filled with zinc oxide and eugenol.

METHOD

Young dogs showing no appreciable abrasion of the permanent anterior teeth were selected for this study. The dogs were prepared for operation by complete anesthesia with sodium pentobarbital, administered intraperitoneally in doses of 1 cc. for each 5 pounds of body weight. A cavity was prepared in the labial surface of each of the four canine teeth. The cavities, which varied in depth, were prepared as near the gin-

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TABLE 1.—EXPERIMENTAL DATA ON DOGS 1-9.

Dog	Duration of Experiment Days	Slide	Treatment	Thickness of Dentin from Pulp to Floor of Cavity (Remaining Dentin) Mm.	Line of Injury	Odontoblastic Reaction	Pulpal Reaction
1.*							
		16	Zinc oxide and eugenol	0.42	No	None	None
2.	5	17	Open cavity	0.42	No	None	None
		18	Open cavity	0.79	No	None	None
		19	Zinc oxide and eugenol	0.34	Yes	Marked atrophy	Circumscribed area of polyblasts
3.†	5	20	Zinc oxide and eugenol	0.40	Yes	Slight disorganization	None
		21	Open cavity	0.62	No	None	None
		22	Open cavity	0.45	No	None	None
		24	Open cavity	0.51	No	None	None
4.	7	25	Zinc oxide and eugenol	0.35	No	None	None
		26	Open cavity	0.90	No	None	Embedding unsatisfactory; torn
		27	Zinc oxide and eugenol	0.68	No	None	None
		35	Open cavity	0.30	Yes	Marked atrophy	Extensive polyblastic infiltration
5.	8	36	Zinc oxide and eugenol	0.49	No	None	None
		37	Open cavity	0.25	Yes	Disturbed in gingival two-thirds of cavity	Slight infiltration of polyblasts
		38	Zinc oxide and eugenol	0.45	No	None	None
6.‡							
		45	Zinc oxide and eugenol	0.30	No	None	None
7.	4	46	Open cavity	0.56	Yes	Slight atrophy	Slight polyblastic infiltration
		47	Open cavity	0.17	Yes	Atrophy	Extensive and marked infiltration of polyblasts
		48	Zinc oxide and eugenol	0.03	No	Atrophy and disorganization deepest part only	None
		55	Open cavity	0.27	Yes	Atrophy	Extensive polyblastic infiltration
8.	4	56	Open cavity	0.47	Yes	Marked disorganization under deepest part	Slight polyblastic infiltration

*Embedding of teeth unsatisfactory.
†Animal underweight and suffering from some skin disease.
‡Animal died before day of final operation.

TABLE 1.—EXPERIMENTAL DATA ON DOGS 1-9 (Continued)

Dog	Duration of Experiment Days	Slide	Treatment	Thickness of Dentin from Pulp to Floor of Cavity (Remaining Dentin) Mm.	Line of Injury	Odontoblastic Reaction	Pulpal Reaction
		57	Zinc oxide and eugenol	0.18	No	None	None
		58	Zinc oxide and eugenol	0.40	No	None	None
		59	Open cavity	0.13	Yes	Atrophy and disorganization	Extensive polyblastic infiltration
9.	6	60	Zinc oxide and eugenol	0.42	No	None	None
		61	Zinc oxide and eugenol	0.08	No	None	None
		62	Open cavity	0.03	Yes	Atrophy	Polyblastic infiltration

TABLE 2.—CHANGES IN OPEN AND IN PROTECTED CAVITIES

Open Cavities			Cavities Protected by Zinc Oxide and Eugenol		
Slide	Thickness of Dentin Between Cavity and Pulp Mm.	Histologic Changes	Slide	Thickness of Dentin Between Cavity and Pulp Mm.	Histologic Changes
62	0.03	Yes	48	0.03	No*
59	0.13	Yes	61	0.08	No
47	0.17	Yes	57	0.18	No
37	0.25	Yes	45	0.30	No
55	0.27	Yes	19	0.34	Yes
35	0.30	Yes	25	0.35	No
17	0.42	No	58	0.40	No
22	0.45	No	20	0.40	Yes
56	0.47	Yes	16	0.42	No
24	0.51	No	60	0.42	No
46	0.56	Yes	38	0.45	No
21	0.62	No	36	0.49	No
18	0.79	No	27	0.68	No
26	0.90	No			

*The only histologic change was a small area of atrophic odontoblasts. This occurred only at the deepest portion of the cavity.

givae as possible with small mounted stones, sharp No. 37 inverted cone burs and No. 558 cross-cut fissure burs. Stones were used only to cut through the enamel and this was done slowly, a current of air being used to avoid appreciable increase in temperature and for the removal of débris. The equipment used permitted operation of the handpiece at a speed as low as 18 revolutions per second. Two of the cavities in each dog were filled with zinc oxide and eugenol following usual clinical method, and two were left open and exposed to the oral fluids. A total of thirty-six cavities were prepared.

At the end of the experimental period,

anesthesia was again produced by the administration of sodium pentobarbital. The abdomen was opened, the diaphragm cut along the left wall and a cannula inserted toward the head into the thoracic aorta and tied. The external jugular veins were then cut and the upper part of the animal was perfused with a warm saline (0.9) solution until the liquid came through comparatively clear.

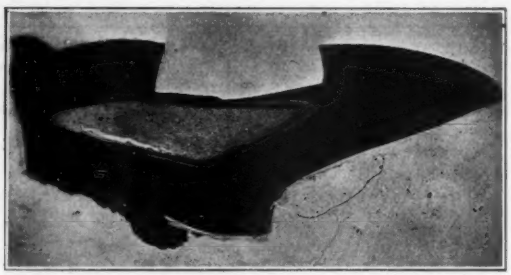

Fig. 1.—Cavity filled with zinc oxide and eugenol; showing relationship of cavity to pulp. (XO eyepiece; 64 mm. obj.)

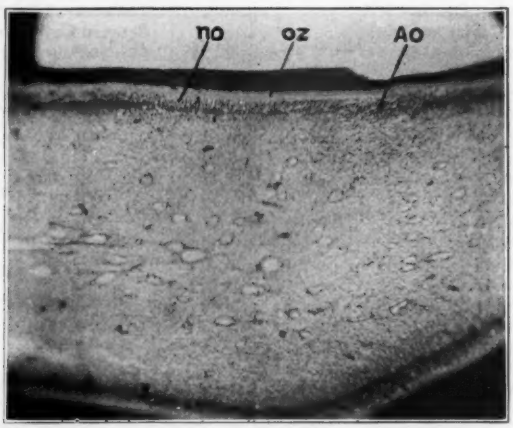

Fig. 2.—Cavity filled with zinc oxide and eugenol. no, normal odontoblasts. oz, odontogenetic zone. ao, atrophic odontoblasts. (XO eyepiece; 16 mm. obj.)

The saline solution was immediately followed by 5 per cent solution of warm formaldehyde and allowed to flow until the jaws of the animal became rigid.

The teeth under consideration were removed surgically and sectioned at the junction of the middle and coronal thirds of the roots. The crown portion of the tooth was then placed in Zenker's formol solution and left for twenty-four hours and washed in running water. The teeth were decalcified by immersion in a 5 per cent nitric acid solution for five days and were then embedded in celloidin. Sections from these teeth 18 microns thick were stained with hematoxylin and eosin. The specimens described and the photographs here shown were taken from serial sections at the deepest part of the cavity.

EXPERIMENTAL FINDINGS

Sections of the four teeth from dog 1 were not satisfactory because of faulty embedding.

In dog 2, one cavity filled with zinc

oxide and eugenol was lost owing to fracture during surgical removal. One of the other three remaining teeth was filled with zinc oxide and eugenol and two were left open. None of the three teeth showed any histologic changes. As seen in Table 1, the remaining dentin (the dentin between the floor of the cavity and the pulp) beneath these three

eral results. This animal was underweight and suffering from a skin disease. One cavity prepared and filled with zinc oxide and eugenol showed a definite line of deeper staining at the junction of the dentin with the predentin. This line, which occurred beneath the deeper portion of the cavity, is the "line of injury" noted by Gurley and Van Huysen, or the

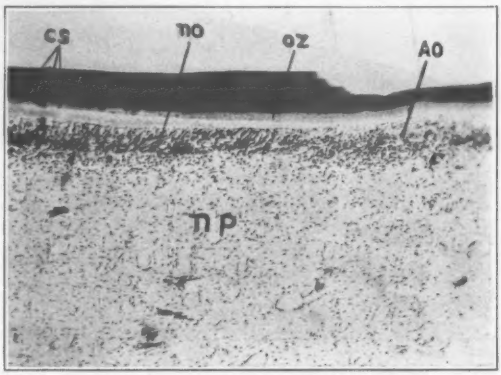

Fig. 3.—Cavity filled with zinc oxide and eugenol. cs, calcospherites. no, normal odontoblasts. oz, odontogenetic zone. ao, atrophic odontoblasts. np, normal pulp. (X8 eyepiece; 16 mm. obj.)

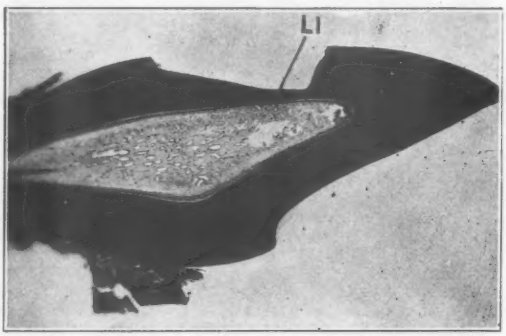

Fig. 4.—Open cavity; showing relationship to pulp. li, line of injury. (Xo eyepiece; 64 mm. obj.)

cavities was 0.42 mm. thick or thicker. As shown in Table 2, in general no reaction occurred in the period of time that the cavities were allowed to remain open if the thickness of remaining dentin was as great as 0.42 mm.

Dog 3 proved an exception to the general results. This animal was underweight and suffering from a skin disease. One cavity prepared and filled with zinc oxide and eugenol showed a definite line of deeper staining at the junction of the dentin with the predentin. This line, which occurred beneath the deeper portion of the cavity, is the "line of injury" noted by Gurley and Van Huysen, or the "barrier" described by Manley. Marked atrophic changes were noted in the odontoblastic layer, with circumscribed areas of polyblastic infiltration in the pulp underlying the cavity. The other cavity filled with zinc oxide and eugenol showed a definite line of injury, with slight

atrophy of the odontoblasts beneath the cavity. In this animal, both cavities, which were allowed to remain open, showed no changes in the histologic picture of the dentin or the pulp. This dog was maintained for a period of five days after cavity preparation. (Table 1.)

The cavities filled with zinc oxide and eugenol in dog 5 suffered no histologic change. The remaining dentin in one of these cavities was 0.49 mm. and the other was 0.45 mm. One of the open cavities, having a remaining layer of dentin 0.30 mm. thick, showed a line of injury,

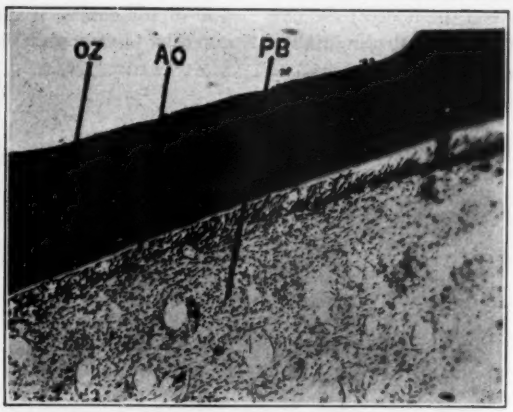

Fig. 5.—Open cavity. oz, odontogenetic zone; showing thinning. ao, atrophic odontoblasts. pb, polyblastic infiltration of pulp. (X8 eyepiece; 16 mm. obj.)

Fig. 6.—Higher magnification of area of polyblastic infiltration in Figure 5. pb, polyblasts. (X8 eyepiece; 4 mm. obj.)

In the four cavities cut in the teeth of dog 4, neither the pulp nor the dentin showed any reaction histologically. In only one of these cavities was the remaining dentin less than 0.42 mm., and this was protected by zinc oxide and eugenol. marked atrophy of the odontoblasts and extensive infiltration of polyblasts in the pulp beneath the cavity. The other exposed cavity, with the remaining dentin 0.25 mm. thick, showed a line of injury, disturbance of the odontoblastic layer

opposite the gingival two-thirds of the cavity and a slight polyblastic infiltration of the pulp in that area. (Table 1.)

Dog 6 died of some intestinal disturbance before the final operation.

One of the cavities filled with zinc oxide and eugenol in dog 7 had a remaining layer of dentin 0.30 mm. thick which showed no histologic reaction. The other with 0.03 mm. of remaining dentin also showed no change except for a small area of atrophic odontoblasts. (Figs. 1, 2 and 3.) One open cavity with remaining dentin 0.56 mm. thick showed a line of injury, slight atrophy of the odontoblasts and slight polyblastic infiltration of the pulp at that area. The other open cavity with remaining dentin 0.17 mm. thick showed a line of injury, atrophy of the odontoblasts and an extensive and marked polyblastic infiltration of the pulp in the area. (Figs. 4, 5 and 6; Table 1.)

In dog 8, one of the cavities filled with zinc oxide and eugenol, with the remaining dentin layer of 0.18 mm. thickness and the other of 0.40 mm., showed no histologic change. Of the open cavities, one with a remaining dentin layer of 0.27 mm. showed a line of injury, atrophy of the odontoblasts and extensive polyblastic infiltration of the pulp beneath the cavity. The other open cavity with a remaining dentin layer of 0.47 mm. showed

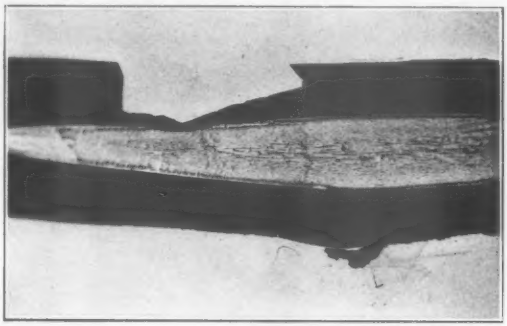

Fig. 7.—Zinc oxide and eugenol in cavity; showing relationship of cavity to pulp. Xo eyepiece; 64 mm. obj.)

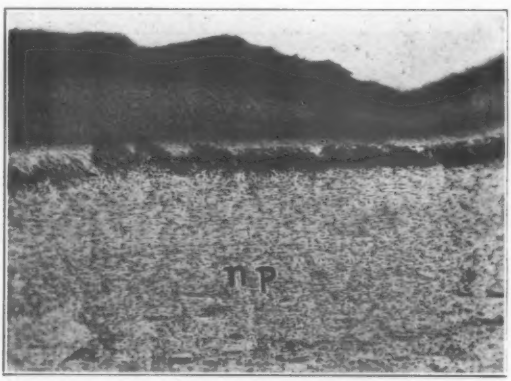

Fig. 8.—Zinc oxide and eugenol in cavity; showing normal pulp; odontoblastic layer torn in sectioning. np, normal pulp. (X8 eyepiece; 16 mm. obj.)

a line of injury and marked disorganization of odontoblasts, with very slight infiltration of polymorphonuclear cells in the pulp underlying the cavity. (Table 1.)

In dog 9, with zinc oxide and eugenol in one of the cavities having a remaining dentin layer 0.42 mm. thick, there was no change in underlying pulp or dentin. The other cavity protected by zinc oxide and eugenol, with a remaining dentin layer of 0.08 mm., gave no evidence of histologic change in the underlying pulp or dentin. (Figs. 7, 8 and 9.) In one of the open cavities with a remaining dentin layer of 0.13 mm., there was a line of injury in the dentin, atrophic changes in the odontoblasts and extensive infiltration of polyblasts in the pulp under the cavity. (Figs. 10, 11 and 12.) The other open cavity, having a remaining dentin layer of 0.03 mm., showed a line of injury in the dentin, atrophic changes in the odontoblasts and marked infiltration of polyblasts in the pulp beneath the cavity. (Table 1.)

In eleven of the thirteen prepared cavities filled with zinc oxide and eugenol, no reaction was observed in pulp or dentin after cavity preparation. In contrast, the fourteen cavities left open showed a histologic reaction in the pulp and dentin in eight instances. This histologic change varied in degree with the depth of the cavity. Generally, the deeper the cavity,

Fig. 9.—Higher magnification of cavity filled with zinc oxide and eugenol. np, normal pulp. (X8 eyepiece; 4 mm. obj.)

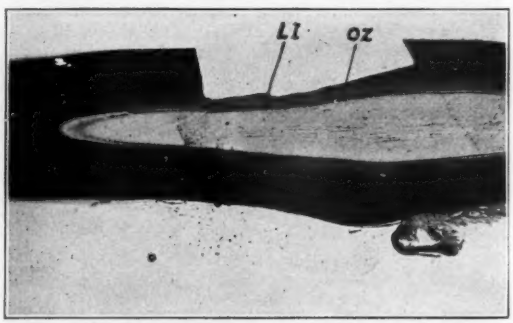

Fig. 10.—Open cavity; showing relationship to pulp. li, line of injury. oz, odontogenetic zone thinned out. (Xo eyepiece; 64 mm. obj.)

the greater the reaction. This effect of depth of cavity preparation is summarized in Table 2.

COMMENT

The results of these experiments indicate that changes in the dentin and pulp follow deep cavity preparation when the cavity is allowed to remain open. The deeper the cavity, the more marked and extensive the reactions of the dentin and pulp to the trauma of operation. On the other hand, when deep cavities were filled with zinc oxide and eugenol, little if any reaction occurred.

The work of Manley,[5] Gurley and Van Huysen,[2] Palazzi,[6] Fasoli[7] and Fish[8] shows that when various types of filling materials, such as red copper cement, zinc phosphate cement, amalgam, temporary stopping and silicate cement, are placed in cavities, definite histologic reactions take place in the pulp and dentin.

Gurley and Van Huysen[9] and Manley,[5] in similar experiments, arrived at the conclusion that zinc oxide and eugenol, either as temporary filling material or as a lining beneath other types of filling materials, afforded protection to the pulp and dentin. We believe that this conclusion is further borne out by this series of experiments.

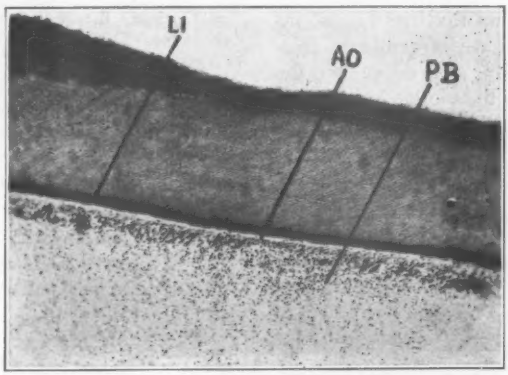

Fig. 11.—Open cavity. li, line of injury. ao, atrophic odontoblasts. pb, polyblastic infiltration. (X8 eyepiece; 16 mm. obj.)

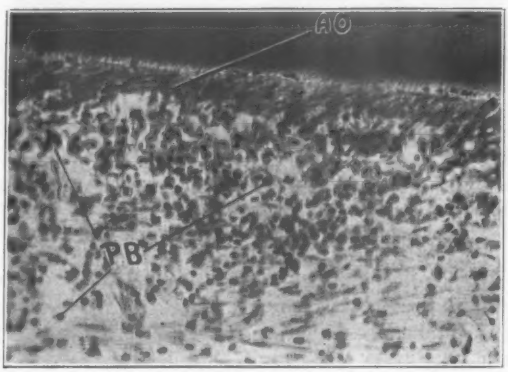

Fig. 12.—Higher magnification of open cavity. ao, atrophic odontoblasts. pb, polyblasts. (X8 eyepiece; 4 mm. obj.)

The location of the line of injury or barrier in relation to the cavity is influenced by the position of the cavity in the tooth. This is because the irritation of the tubuli that are cut takes place along the course of each tubule and causes a response at the pulpal end. Since the angulation of these dentinal tubuli changes with the different surfaces of the tooth, it follows that the line of injury will be located differently in relation to the cavity, depending on the latter's location in the tooth. An example of the line of injury extending well below the gingival limit of the cavity is shown in Figure 13. The tubuli cut at the gingival floor of the cavity (a) can be seen extending at an angle to the gingiva as they approach the pulp, at b, on the line of injury.

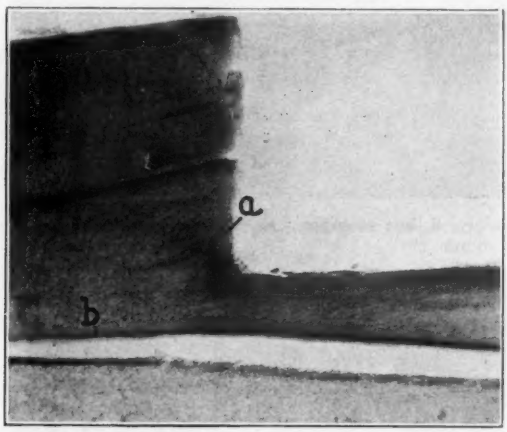

Fig. 13.—Location of line of injury relative to angulation of dental tubule. a, peripheral end of cut tubule terminating near b. b, gingival extent of line of injury. (X8 eyepiece; 16 mm. obj.)

CONCLUSIONS

1. No cavity should be allowed to remain open and unprotected.

2. The use of zinc oxide and eugenol will protect the cut tubuli, preventing reactions in dentin and pulp.

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THE EFFECT OF PARTICLE SIZE ON DIMENSIONAL CHANGE IN DENTAL AMALGAMS (I)

By Joseph R. Jarabak, D.D.S., Indiana Harbor, Ind.

ALTHOUGH dental amalgam has been the object of many investigations, little literature is available on the effect of particle size and dimensional change. Early work[1, 2] in this field demonstrated the need for fundamental knowledge of particle size as a physical property of amalgam.

The present investigation deals with the effects of the variables of particle size, trituration, condensation and composition on dimensional change.

REVIEW OF LITERATURE

Gray[1, 2] has demonstrated the effect of particle size on dimensional change. G. V. Black[3] and M. L. V. Gayler[4, 5] have shown the effects of composition on dimensional change. Ward and Scott[6, 7] studied the effects of manipulation variables on dimensional change. Recently, Skinner,[8] with a mechanical amalgamator and mechanical plugger, described by Sweeney[9] and Romnes,[10] demonstrated the effect of this type of manipulation on physical properties. Worner[11] demonstrated the effect of ingot annealing on certain physical properties.

METHODS AND LABORATORY PROCEDURES

1. *Testing Procedures.*—Four alloys were purchased on the open market. Their composition is indicated in the accompanying table. The alloys were all sieved in 100, 200 and 325 mesh sieves. The particle sizes used in this investigation were retained in 100, 200 and 325 mesh sieves, and those passing a 325 mesh sieve. The accompanying table shows the microscopic measurements for the above-mentioned particles of the four alloys used; also the percentage of particles retained and passing the above-mentioned sieves. All percentages listed in the table were based on two-minute sievings in each of the above-mentioned sieves. All references to particle size in the graphs and tables will be referred to as R (retained by), or P (passing) the respective sieves. Dimensional tests were all made at 37° C. ±1 (98.6° F.). Otherwise, all procedures and equipment were as required in A.D.A. Specification No. 1 for the Testing of Dental Amalgam.

Trituration was done with a No. 8 mortar and pestle for one and two minutes, respectively, with fifteen-seconds "palming." A 7:5 mercury:alloy ratio was used. Condensation was done by means of an adjustable constant pressure instrument. Three and eight pounds condensing pressures, respectively, were used with 135 thrusts on a 2 mm. condenser point.

Seven and twelve seconds, respectively, were used for mechanical amalgamation. The mix was divided into ten sections. The mercury in the first section was expressed between the thumb and forefinger before condensation, and in the remaining sections in a linen towel.

The mechanical amalgamator vibrates 172 times in ten seconds, and the mechanical condenser delivers 142 thrusts for ten seconds.

Read before the Section on Therapeutics, Pathology and Research at the Seventy-Seventh Annual Midwinter Meeting of the Chicago Dental Society, February 19, 1941.

2(a).—Dimensional Change for Particle Size (Variable); Trituration, Condensation Pressure (Constant).—Figure 1 shows a series of graphs obtained from alloy B when condensation pressure and trituration time were constant. The variable factor was particle size. The range of dimensional variation for this particular manipulation was approximately 6 microns for each particle size used. The coarse particles, R 200, had the highest expansion. R 325 had 6 microns less expansion; P 325, 6 microns less expansion, than R 325. The total dimensional variation between R 200 and P 325 was 12 microns. The results were obtained in two or three trials.

(b).—Trituration and Particle Size (Variable); Condensation Pressure (Constant).—The effect that trituration and particle size as variables have on dimensional change for a constant condensation pressure is illustrated in Figure 2. It can readily be seen that trituration and particle size are definite factors in dimensional change.

Other investigators,[6] using unsieved alloys, demonstrated that, as trituration time increases, expansion decreases. A similar effect is shown in Figure 2. However, it should be noted that a decrease in particle size causes a lessening of the effect of trituration on dimensional change.

(c).—Particle Size and Condensation Pressure (Variable).—When trituration is a constant factor, the effect of condensation pressure and particle size on dimensional change is as shown in Figure 3. The particle size showing the greatest variation is R 200. There is approximately 7 microns less expansion for R 200 as the condensation pressure is increased to 8 pounds. R 325 is not so sensitive to condensation pressure as is R 200; the change from a 3-pound condensation pressure to an 8-pound showing only a 2 micron drop. P 325 is perhaps least sensitive to the higher condensation pressure, the reduction in dimensional change being only 1 micron. The graph indicates that as the particle

PARTICLE SIZES OF FOUR ALLOYS USED

Composition Per Cent	Sieved Particles Per Cent by Weight	Microscopic Size of Particles (Mm.)	
		Length	Width
Alloy 1			
Ag 70.3	R 100 17.6	0.765	0.081
Sn 25.5	R 200 39.4	0.351	0.054
Cu 2.4	R 325 32.4	0.245	0.043
Zn 1.8	P 325 9.8	0.125	0.037
Alloy 2			
Ag 68.7			
Sn 26.8			
Cu 3.5	P 325 99.3	0.049	0.027
Zn 1.0			
Alloy 3			
Ag 68.1		0.374	0.067
Sn 26.3	R 200 36.8	0.258	0.045
Cu 4.5	R 325 46.0	0.129	0.039
Zn 1.1	P 325 16.3	0.0065	0.0065
Alloy 4			
Ag 74 to 76	R 200 12.02	0.293	0.063
Sn 25 to 26	R 325 51.2	0.251	0.046
Zn 0.5 to 1.5	P 325 35.5	0.128	0.038

size for this alloy (alloy B) becomes smaller, the reduction in dimensional change existing between the two previously mentioned condensation pressures becomes less.

(d).—Effect of Mechanical Trituration, Condensation and Particle Size on Dimensional Change.—Figure 4 shows the effect of mechanical trituration, condensation and particle size on dimensional change. The graphs in Figure 4 indicate that the effect of variation in shrinkage of 0.5 micron exists (change of 4.5 microns from a seven to twelve second amalgamation for particle size R 325). P 325 shows a shrinkage for both seven and twelve seconds. R 325 and P 325 have a dimensional variation of 8 microns for seven-seconds trituration.

When amalgamation is carried to twelve seconds, the dimensional variation for R 325 and P 325 is 3 microns.

This method of amalgamation and

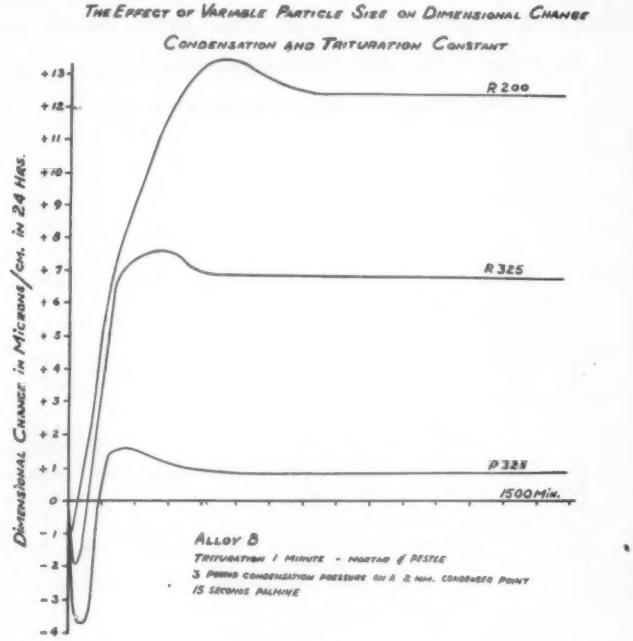

Figure 1.

mechanical amalgamation on dimensional change is quite marked. R 200, mechanically amalgamated for seven seconds, shows an expansion of 10 microns. When the amalgamation is for twelve seconds, the dimensional change for R 200 drops to approximately 4 microns. R 325, mechanically amalgamated for seven seconds, shows a 4-micron expansion; but when the same size particle is amalgamated for twelve seconds, a condensation has a more pronounced effect with respect to shrinkage on the finer particle sizes than on the coarser particle sizes.

(e).—Particle Size: Trituration (Variables); Mechanical Condensation (Constant).—The effect of particle size and variable trituration with mechanical condensation on dimensional change is shown in Figure 5. R 200, with one minute trituration in mortar and pestle,

shows a final expansion of 6.5 microns; whereas a final expansion of 3.5 microns is seen when the trituration time is increased to two minutes (dimensional drop of 3 microns). R 325, one minute trituration, shows a final expansion of 1 micron. When the trituration time is increased to two minutes, a shrinkage of 2 microns is noted in the final state (dimensional drop of 3 microns). P 325 shows a shrinkage of 1.5 microns for one minute trituration, and a shrinkage of 4.5 microns for two minute trituration (dimensional drop of 2.5 microns).

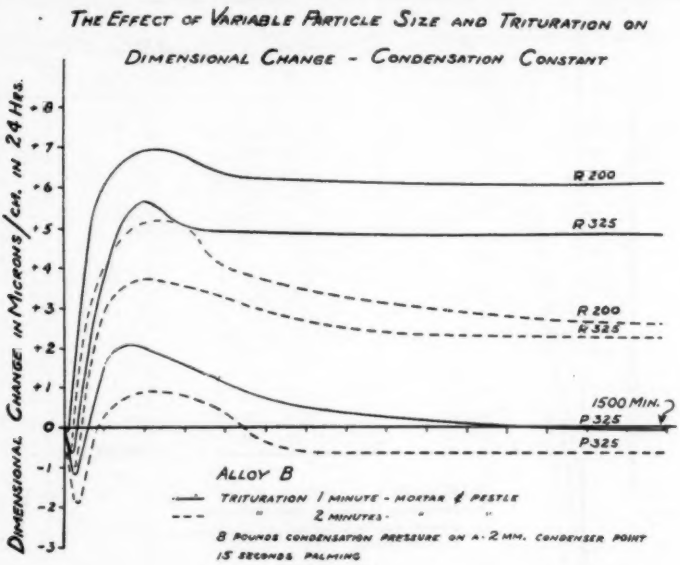

Figure 2.

The series of graphs in Figure 5 show that the greatest sensitivity with regard to dimensional change is between R 200 and R 325 for a variable trituration time, and for a definite condensation procedure.

Although it is not the purpose of this paper to show the effects of composition upon dimensional change, the four alloys of different composition were studied, and therefore results will vary. This has been previously demonstrated.[3, 4, 5, 11] These facts must be kept in mind when interpretation of the data to follow is made.

3 *(a).—Effect of Particle Size on Dimensional Change of Four Alloys (Condensation and Trituration Constant).*—Figure 6 represents the dimensional change shown in four alloys of different composition. The condensation pressure and trituration time were constant factors.

Alloys A and C show a greater sensitivity between R 200 and R 325 than for any other particle size. However, alloy D, which passed the 325 mesh sieve to the extent of 99.3 per cent for a two-minute sieving period, shows an expansion of 7 microns. Alloy B shows that a greater sensitivity exists between R 325 and P 325 than for the other particle sizes.

(b).—Particle Size and Trituration (Variables); Condensation Pressure (Constant) for Four Alloys.—The effect that particle size has on dimensional change when the trituration is variable and the condensation pressure is constant is shown in Figure 7.

Alloy A shows a uniform dimensional decrease of 3 microns, with an increase in trituration time of from one to two minutes for R 100, R 200 and R 325. This is altered somewhat for P 325, where the dimensional decrease is less than 1 micron.

Alloy B shows an even greater sensitivity for R 200 and R 325 than alloy A. P 325 shows a fractional decrease from a one to a two minute trituration. The least sensitive grain size in alloys A and B is P 325.

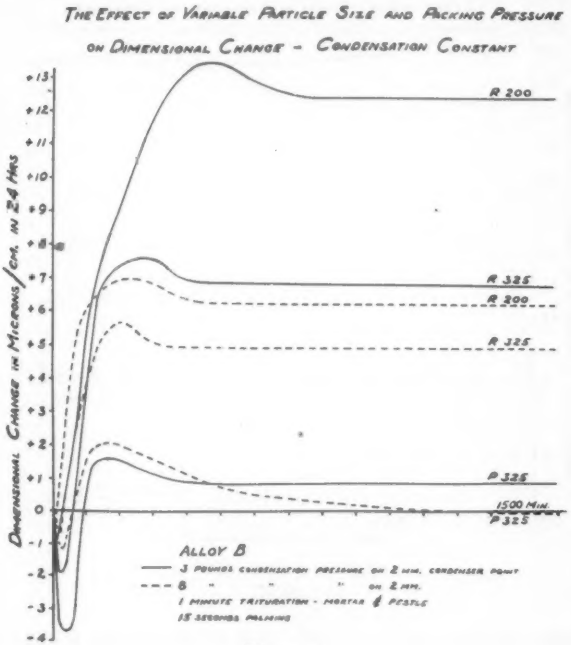

Figure 3.

Alloy C shows a different result in that R 200 and R 325 have only a 2 micron dimensional decrease. P 325 shows a 3 micron dimensional decrease. This would indicate that P 325 is most sensitive to a trituration time increase.

Alloy D shows a 4 micron dimensional decrease with a one minute trituration increase. This alloy is similar to alloy B with respect to the trituration variable. It must, however, be considered that this alloy is in the P 325 group; and, as previously noted, the P 325 size was the least sensitive for alloys A and B.

(c).—Particle Size and Condensation (Variables); Trituration (Constant).—Figure 8 illustrates the effect of variable particle size and condensation pressure upon dimensional change for alloy A. The trituration time was constant. When the alloy was condensed under 3 pounds pressure (a_1), the dimensional decrease between R 100 and R 200 was 1.8 microns. The dimensional decrease between R 200, R 325 and P 325 was approximately 3 microns. The results were somewhat different for 8-pound condensation (a_2), R 200 showing only a fractional decrease from the results obtained in R 100. The greatest sensitivity came between R 200, R 325 and P 325. All specimens condensed with a mechanical condenser for 100 seconds (a_3) had a uniform dimensional decrease of 1 micron for R 200, R 325 and P 325. The

dimensional decrease between R 100 and R 200 was 2 microns, which indicates that the greatest sensitivity existed between R 100 and R 200.

Figure 8 (b_1) illustrates the results obtained for alloy B. These results for 3 pound condensation pressure were similar to those obtained for the same condensation pressure in alloy A with regard to the uniformity of dimensional decrease. However, the magnitude of decrease is 5 microns (about 3 microns greater for each particle size than is shown for alloy A). When an 8-pound condensation pressure was used (b_2), the dimensional decrease for each particle size was uniform again; approximately 3 microns. The results obtained with mechanical condensation (b_3) showed the greatest variability between R 200 and R 325. The greatest sensitivity came between R 200 and R 325. R 325 and P 325 showed the least dimensional change for this type of condensation.

The 3-pound condensation for alloy C (c_1) had a dimensional decrease of 2 microns from R 200 to R 325. The particle sizes R 325 and P 325 were the least sensitive. Only a fraction of a micron was noted in dimensional decrease. Specimens condensed with an 8-pound condensation pressure (c_2) showed a dimensional decrease of 0.75 micron between R 200, R 325 and P 325. The use of mechanical condensation (c_3) showed but a slight dimensional decrease between R 200 and R 325. The particles most sensitive to this method of condensation are P 325. In this alloy, P 325 had a 1.5 micron shrinkage.

Since all the particles in alloy D pass the 325 mesh sieve, results are illustrated by one vertical line for each condensation procedure. The dimensional decrease from a 3-pound condensation pressure (d_1) to an 8-pound condensation pressure (d_2) was 1 micron. The results obtained with mechanical con-

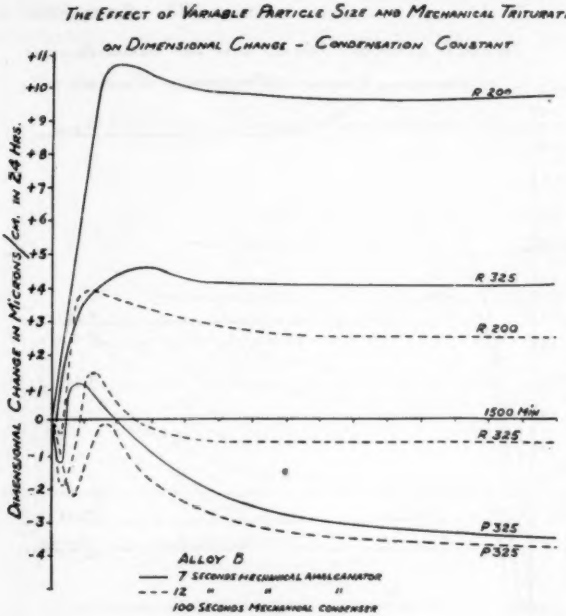

Figure 4.

densation indicated a 4.5 micron dimensional decrease from the 8-pound condensation pressure (d_2) to the mechanical condensation (d_3). The greatest sensitivity to the condensation variables came between the 8-pound condensation pressure and mechanical condensation (d_2 and d_3).

(d). Particle Size, Mechanical Amalgamation (Variables) and Mechanical Condensation (Constant).—Figure 9 illustrates the effect of variable particle size and mechanical amalgamation on sensitivity to dimensional change came between R 200 and R 325.

Alloy B showed that the greatest dimensional variation to mechanical amalgamation was between R 200 and R 325. The decrease dimensionally from a seven second to a twelve second amalgamation for R 200 was 8 microns. R 325 showed only a 3.5 micron decrease for the same amalgamation periods, whereas P 325 showed less than 1 micron difference between R 325 and P 325. The greatest sensitivity to dimensional change came

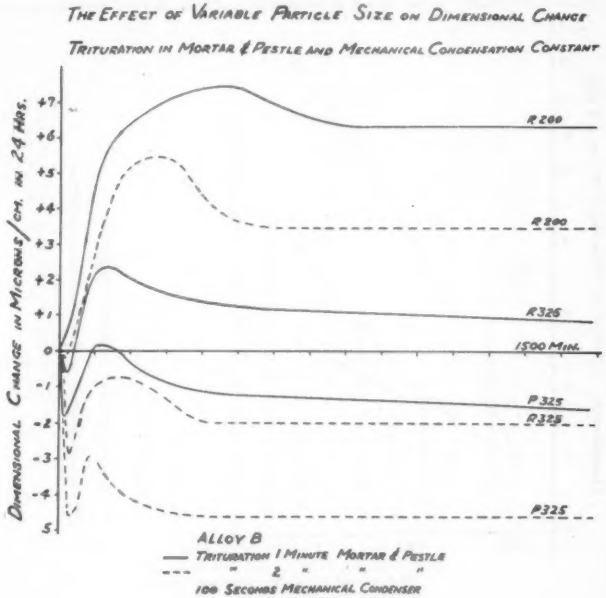

Figure 5.

dimensional change for a constant mechanical condensation. In alloy A, the dimensional decrease from a seven second mechanical amalgamation to a twelve second mechanical amalgamation approximated 2.5 microns for R 100. R 200 decreased dimensionally 1.5 microns for the same procedure. R 325 showed a 1.5 micron dimensional decrease from a seven second to a twelve second amalgamation. On the basis of these figures, it appears that the greatest between R 200 and R 325 in the seven second amalgamation procedure.

Alloy C showed a very small dimensional decrease for the seven second to the twelve second amalgamation; approximately 0.5 micron. This same dimensional variation exists between R 200, R 325 and P 325, respectively. The results obtained for the mechanical procedure were uniform.

Alloy D showed a dimensional decrease from a seven second to a twelve

second amalgamation of 2 microns. However, it must be noted that this alloy lay very close to the zero point for the seven second amalgamation. A definite shrinkage was noted when the amalgamation was for twelve seconds.

INTERPRETATIONS OF DATA

The available information on the effects of particle size on dimensional change is very meager. Gray[1] demonstrated the effect of variable condensation pressure on one particle size of a sieved alloy. The results that he reported are for particles passing the 200 mesh sieve. Beyond this point, the particle gradients and their effects are unknown, as no measurements were reported for the smaller particle sizes. Gray[2] also points out the effect of particle sizes upon dimensional change for a definite condensation pressure from considerably coarser particles than are now available in commercial alloys. These data are again limited in the particle sizes ranging below a 200 mesh sieve. The size of the smaller particles referred to in his early work carried no specification as to the size of particles. Another factor of significance is that in the intervening period between the early work in this field and the present investigation, the A.D.A. Specification No. 1 for Testing of Dental Amalgam has been formulated, and the composition and procedures may have changed. The results obtained in this investigation do not show the marked differences previously reported.

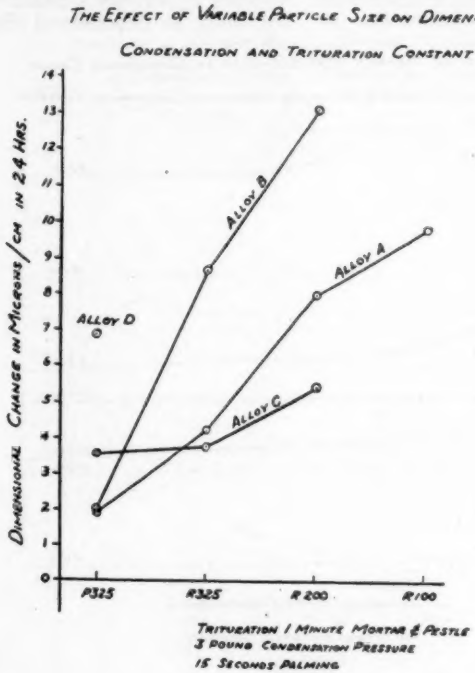

Figure 6.

Figures 1 to 5 inclusive demonstrate the changes in the reaction expansion curve when such factors as particle size, condensation and types of amalgamation were variables. The constant factor was

composition (alloy B). Figures 6 to 9 inclusive illustrate the effects of such variables as particle size, condensation, amalgamation and composition on alloys A, B, C, D. These charts are represented in vertical lines for maximum expansion and maximum contraction. They were charted for a twenty-four hour period.

Ward and Scott,[10] who demonstrated the effect of trituration and condensation on the reaction expansion curve, concluded that as the trituration time increased and expansion time decreased; and, as the condensation pressure increased, the expansion decreased. It was shown in Figure 1 that, for a given trituration time and condensation pressure, the typical expansion curve indicated a dimensional decrease which was rather uniform. Figure 2 demonstrates that these typical curves are altered by trituration time increase. The uniformity was altered in two respects: first, as the trituration time increased, the dimensional decrease was very marked; secondly, a greater sensitivity was apparent between R 325 and P 325. Figure 7 demonstrates the dimensional variations which existed between the particle sizes of the respective alloys for variable trituration time and a given condensation pressure. A decrease in dimensional change for an increase in trituration time was noted. The decrease was not particularly uniform, but the greatest sensitivity was seen between R 200 and R 325.

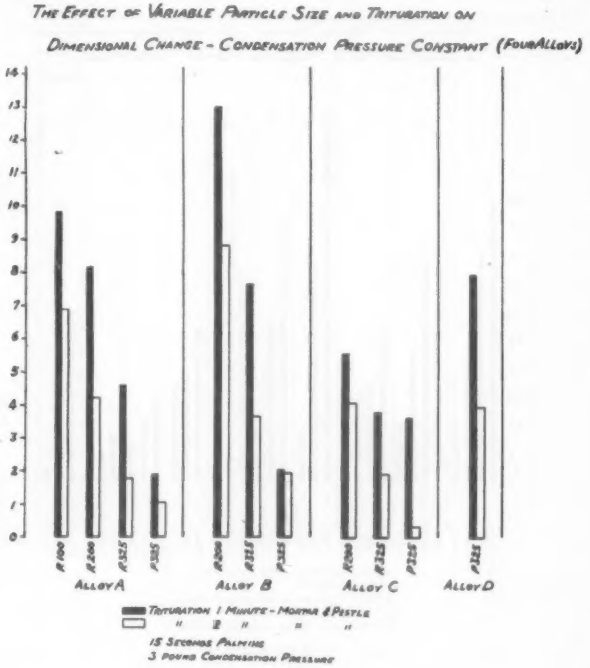

Figure 7.

The greatest deviation in dimensional decrease with an increase in trituration time was noted in alloy B. The next deviation in magnitude came in alloy A. Alloy C showed the least dimensional change. No such comparison could be made for alloy D because it was com-

posed of but one particle size, P 325. P 325, when compared as to particle size with the other alloys in Figure 7, showed, for a given trituration time, a higher dimensional change. Time does not permit a discussion of the extreme sensitivity of alloy D to variation in trituration time.

The findings of this investigation are in accordance with those of Ward and Scott with respect to dimensional change decrease with an increase in trituration and 100-second mechanical condensation corresponds with the one to one and a half minute mortar and pestle trituration and 8-pound condensation. The twelve-second mechanical amalgamation and 100-second mechanical condensation correspond with the two to two and one-half minute mortar and pestle trituration and 8-pound condensation. These conclusions are based on dimensional change data within the ranges mentioned. A full appraisal of mechanical procedure

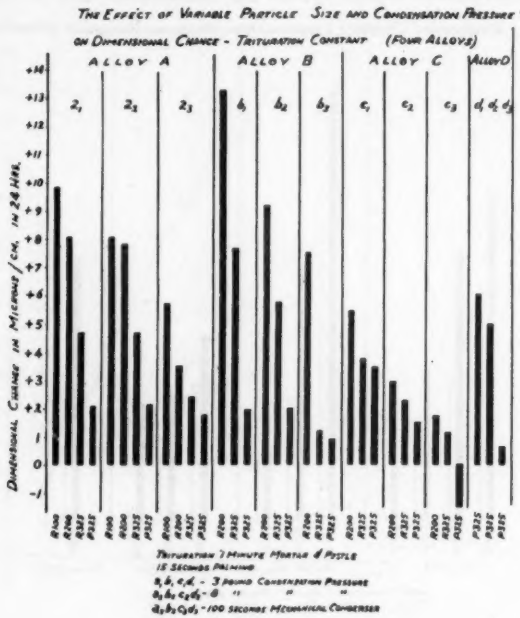

Figure 8.

time. However, the factor of particle size has been added as a variable. The results in dimensional change have been clearly demonstrated for given trituration procedures. Although the results of mechanical amalgamation and condensation and their effects on dimensional change have been studied, the effects of this procedure and the mortar and pestle trituration with hand condensation can only be estimated by comparison. The seven-second mechanical amalgamation and its effects on dimensional change will be reported at a later date.

The effect of variable condensation and particle size on dimensional change shown in Figure 3 illustrates the range of dimensional change variation for the different particle sizes with 3-pound and 8-pound condensation pressure. The significant point here is that, as the condensation pressure was increased, the uniformity between dimensional decrease became better established. When me-

chanical condensation was used with mortar and pestle trituration for a given time, the greatest sensitivity came between R 200 and R 325. There was approximately a 7-micron dimensional decrease. However, the dimensional variation existing between R 325 and P 325 was fractional.

In Figure 8 a_{1-3}, b_{1-3}, c_{1-3}, the effect of 3-pound and 8-pound condensation pressures, and 100-second mechanical condensation was shown. It may be noted from this chart that all sizes are not responsive to condensation increase in the same degree; but that particle sizes R 100, R 200 and R 325, in nearly all instances, are within close range of dimensional variation. The greatest sensitivity existed between R 200 and R 325 in most instances. Alloy C showed a more nearly uniform decrease on condensation pressure increase.

Alloys A, B, C, and D were well within a 3-micron dimensional decrease for particle sizes ranging from R 100 for alloy A to R 325 for alloys B, C and D. The greatest sensitivity came between R 200 and R 325.

The effects of particle size on the dimensional change curve shown in Figure 1 can be partly explained by Gayler's theory for the setting of dental amalgam. The theory is based on several reaction phases which take place when mercury is added to amalgam alloy. Basically, there are two components: the intermetallic compound Ag_2Sn and mercury. Gayler believes that setting reaction takes place in two steps. The first step begins with the inception of trituration,

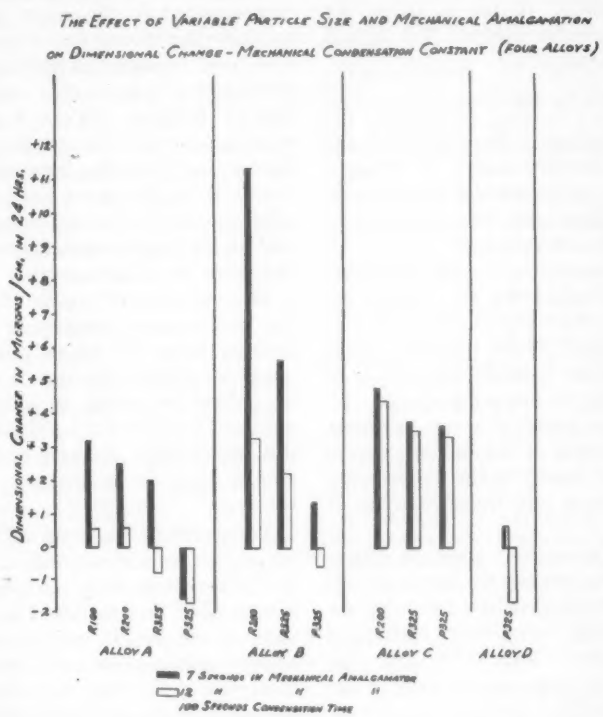

Figure 9.

with the primary coating of the particles with mercury. The reaction is as follows:

$$Ag_3Sn + Hg \rightarrow \beta_1 + \gamma_2$$

On the basis of the equation, it is believed that the first step is the transformation of Ag_3Sn, a solid solution of mercury in Ag_3Sn and a formation of a sheath of $\beta_1 + \gamma_2$ which decreases as the phase increases. The γ_1 phase is a silver-mercury system in which the tin is held in solid solution. In the γ_2 phase, we have a tin-mercury system. The second reaction is as follows:

$$\beta_1 + \gamma_2 \rightarrow \beta_1 + \gamma_1 + \gamma_2$$

The new phase in this reaction is the γ_1, a silver mercury system, in which a small amount of tin remains in solid solution. This phase may, in some way, be related to the intermetallic compound Ag_3Hg_4. Nevertheless, the residual mercury is responsible for the second reaction. The effect of particle size is relatively important. If the particle is large and the mercury is insufficient, a core of Ag_3Sn may be left surrounded by $\beta_1 + \gamma_2$, with the formation of $\gamma_1 + \gamma_2$ resulting from the reaction of the mercury found between the coated grains, preventing further diffusion and transformation of Ag_3Sn.

From the foregoing, after the coarse particles are triturated, the amalgam will in all probability give the following reaction: a large amount of unchanged Ag_3Sn; β_1 and a little of γ_1, and very little of γ_2. If next the mercury is expressed so that it is between 40 and 47 per cent, the setting reaction will be: β_1 to $\gamma_1 + \gamma_2$, the amounts of $\gamma_1 + \gamma_2$ depending on the mercury content. The less mercury, the greater the amount of γ_2 to be formed. It may be concluded from this theory that since only a small amount of Ag_3Sn is attacked, and the formation of β_1, γ_1 and γ_2 are relatively small, expansion will result with the use of large particle sizes. These theories are substantiated by laboratory findings.

In accordance with the theory, when fine particle sizes are used, the resulting amalgam will contain little unchanged Ag_3Sn with possibly a small amount of β_1. The greatest part will be $\gamma_1 + \gamma_2$ after expressing the mercury. According to the theory, the reaction will be very little β_1 and $\gamma_1 + \gamma_2$. Gayler believes that the amount of γ_2 should be very small in comparison to γ_1.

The laboratory findings, as previously demonstrated in Figures 1 and 7, substantiate the theory for coarse particles. The point brought out by Gayler on fine particle size is in conflict with the laboratory findings. There is a possible explanation for this conflict, it being known that when the intermetallic compound of Ag_3Sn reacts with mercury, a solid solution of mercury in Ag_3Sn forms and marked contraction takes place. On this basis, it can be seen that since there is little unchanged Ag_3Sn, the solution has gone to near completion. The contraction factor of Ag_3Sn plus the contraction exhibited by the γ_2 phase may be sufficiently potent to affect the expansion factor of the γ_1. On the basis of this explanation, the results in the laboratory are in accordance with the theory.

There remains one factor in this investigation that is in conflict with Gayler's theory regarding particle size; this is with alloy D. On the basis of particle size, all in the P 325 class, alloy D showed an expansion considerably higher than that of all other alloys for this particular particle size. From this theory, it might be assumed that the composition of the alloy was on the high side of the Ag_3Sn with regard to silver or below 25 per cent tin. In the table, it was shown that this does not seem to be the case. The significance of manufacturing variables has been reported by Worner. These variables, in all probability, are responsible for the relatively high expansion of a P 325 particle size in alloy D.

It may be further stated that any clinical procedure which increases the reaction of mercury with Ag_3Sn and aids in the formation of γ_2 in excess will cause a shrinkage, and, conversely, a procedure which reduces the attack of mercury on Ag_3Sn with an increase in γ_1 will cause a dimensional increase. Hard grinding of alloy particles increases the reaction of mercury with Ag_3Sn; light pressure in mortar and pestle decreases the mercury attack on Ag_3Sn.

CONCLUSIONS

1. Expansion decreases as the particles become smaller. The decrease is not particularly uniform, but in most instances shows the greatest sensitivity between R 200 and R 325.

2. All alloys used in this investigation do not respond alike to dimensional decrease in particle size for a given trituration.

3. The reduction in particle size influences dimensional decrease in the same ratio as does the increase of condensation pressure from 3 to 8 pounds.

4. The response to dimensional change of the various particle sizes for variable trituration periods is not in any definite ratio. However, as the trituration time increases, the dimensional change decreases for all particle sizes.

5. Mechanical amalgamation within a given period of time has the same effects on dimensional change as does mortar and pestle trituration for a given period of time.

6. Mechanical condensation for a given period showed approximately the same effect on dimensional change as did the 8-pound condensing pressure for the coarser particle sizes. It does cause contraction when used with the finer particle sizes.

7. An increase in condensation pressure from 3 to 8 pounds caused a dimensional decrease in most instances of not more than 3 microns.

8. Laboratory findings substantiate existing theories for the setting of amalgams.

9. Decrease in particle size causes a lessening of the effect of trituration on dimensional change in practically all alloys used.

10. As the particles become smaller, the effect of condensation on dimensional change becomes less apparent.

11. In most instances, a greater sensitivity to dimensional change existed in the coarser particle sizes for given trituration and condensation.

12. Although all alloys responded alike to the variables, the magnitude of this response is controlled by the composition and manufacturing procedures.

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BACTERIOLOGIC AND IMMUNOLOGIC STUDIES IN DENTAL CARIES: A PRELIMINARY REPORT

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THE diversity of opinion that exists concerning the etiology of dental caries indicates how thoroughly the subject has been investigated. In approaching the problem from the bacteriologic aspect, it is understandable that much confusion exists when one considers the heterogenicity of the oral flora and the intimate association of the saliva with the exposed portions of the tooth. Cultures from dental plaques or of superficial material from incipient carious lesions will, unless an acid broth is employed, usually exhibit a variety of micro-organisms. Microscopic smears made from the same areas frequently show a similar picture. It is obvious, therefore, that, in the bacteriologic approach, one is confronted with the bewildering problem of evaluating the importance of these many species in the production of dental caries.

Miller[1] believed that any organism normally present in the mouth and capable of producing acid fermentation might take part in the initial carious lesion. He did not recognize as part of the oral flora any bacterium similar to *Lactobacillus acidophilus,* the organism, isolated by Moro,[2] which has played such an important rôle in studies on dental caries. The early mention by Goadby[3] of *Bacillus necrodentalis,* an acid-producing organism, together with the subsequent observations of Kligler[4] and Howe and Hatch,[5] indicated the importance of gram-positive rods belonging to the *Lactobacillus acidophilus* group in carious teeth and in carious mouths.

Recognizing the probable importance of acid-forming organisms in the production of dental caries, Rodriguez[6] and McIntosh, James and Lazarus-Barlow,[7] by employing acid culture media, were able to isolate lactobacilli routinely from carious lesions of extracted teeth and to subsequently produce caries-like lesions by immersing extracted teeth in broth cultures of the organisms located. The importance of these findings was later confirmed by a number of investigators.[8, 9, 10, 11, 12, 13] Much confusion existed, however, because, in certain instances, these organisms could be isolated from mouths apparently not susceptible to dental caries, indicating that, in some individuals, the growth characteristics and activity of these organisms were variable.

While these essentially qualitative methods furnished valuable data and aroused renewed interest in the bacteriologic phase of caries, the development of a quantitative procedure by Rodriguez[14] by which the number of lactobacilli per cubic centimeter of saliva could be estimated, later modified by Hadley,[15] greatly broadened the concept of *L. acidophilus* in the carious process. Using this method, other investigators[16, 17, 18, 19] have reported a close correlation between the number of *L. acidophilus* organisms in the saliva and dental caries activity. Other reports have questioned the importance of these lactobacillus findings in caries production,

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attaching considerable importance to the streptococci[20, 21, 22, 23, 24, 25] and, to a lesser extent, certain yeastlike organisms.[20, 26] Knighton,[27] in a recent study of the monilia of the oral cavity, found no correlation between caries and the presence of yeast-like organisms. Since streptococci are uniformly present in the saliva of all mouths, and therefore in contact with all exposed surfaces of the teeth, their presence in the superficial débris of carious lesions and dental plaques is to be expected. The streptococci are non-aciduric and of low acidogenic powers when compared with the lactobacilli. Further, the fact that they are seldom isolated from deep carious dentin[28] suggests that, in the light of present-day knowledge, caution must be exercised in placing emphasis on their rôle in the production or initiation of the carious lesion.

PREVIOUS STUDIES OF THE ORAL LACTOBACILLI

The morphologic, cultural and biochemical characteristics of *L. acidophilus* have been observed in this laboratory over a period of several years. Studies have included several hundred strains isolated both from superficial and from deep carious lesions and from the saliva of caries susceptible and non-susceptible individuals. With the exception of a few strains isolated in glucose-brain broth reported by us in a previous communication,[28] all of the organisms were obtained in pure culture by the initial employment of an acid broth of various pH concentrations or from tomato-agar plates (pH 5.1). Stock cultures were maintained at room temperature on peptonized milk-agar and trypsin digest-agar slants.

When we attempted to classify the

TABLE 1.—STRAINS ISOLATED IN PURE CULTURE

Specimen	Strain Designation	Type of Colony	Specimen	Strain Designation	Type of Colony
D-5	D-5-A	No. 1	D-14	D-14-A	No. 1
	D-5-B*	No. 2		D-14-B	No. 1
D-7	D-7-A	No. 1	D-17	D-17-A	No. 1
	D-7-S	No. 2		D-17-B	No. 1
	D-7-RS	No. 2			
			D-22	D-22-D-1	No. 1
				D-22-K	No. 3
D-8	D-8-A	No. 1			
	D-8-S	No. 2	D-26	D-26-A	No. 1
	D-8-F†	No. 2		D-26-B	No. 2
	D-8-FS‡	No. 2		D-26-D	No. 3
D-9	D-9	No. 1	D-28	D-28	No. 2
				D-28-C	No. 3
D-12	D-12-A	No. 1			
	D-12-B	No. 1	D-29	D-29-1	No. 1
	D-12-C	No. 3		D-29-2	No. 2
D-13	D-13-A	No. 1	D-30	D-30-1	No. 1
	D-13-B	No. 2		D-30-2	No. 2
	D-13-C	No. 1			

*Lost on subculture.
†Similar to D-8-S, except friable, slides along media.
‡Variant developed from D-8-F, but butyraceous.

various individual strains on the basis of structure, cultural characteristics and biochemical activities, considerable variation appeared, indicating that the oral lactobacilli constituted a large heterogeneous group of micro-organisms. On further observation, it was also evident that individual strains were unstable or variable in their characteristics. The structure and colony form not only correlate the structure and the colonial appearance with the fermentative or other biochemical activities. That *L. acidophilus* is highly pleomorphic has been shown by a number of investigators.[8, 20, 29, 30, 31, 32, 33, 34] Howitt,[35] recognizing their instability, maintained original stock strains in brain medium in the refrigerator for a period of two years and repeatedly purified the cultures before making cultural and serologic studies.

TABLE 2.—HUMAN EXPERIMENTATION

Patient	Vaccine	Period of Vaccination		Number of Intracutaneous Doses		Average Number of Lactobacilli per Cc. of Saliva		Titer of Serum	
		First Inoculation	Last Inoculation	Dilute Antigen	Concentrated Antigen	Before Vaccination	After Vaccination	Before Vaccination	After Vaccination
R.C.S.	D-7-A	4/18/41	6/16/41	5	8	222,460	65,800	1:80	1:160
H.E.G.	D-7-S	4/24/41	6/16/41	4	8	70,800	37,466	1:320	1:320
R.Y.S.	D-7-S	5/19/41	6/25/41	3	6	85,466	36,000	1:160	1:160
	D-7-A	6/28/41	7/21/41	0	12			1:80	1:320
R.B.G.	D-9	5/19/41	7/21/41	10	11	64,000	3,133	1:20	1:160
H.C.M.	D-7-A	5/19/41	7/21/41	11	11	243,333	1,933	0	1:80
B.L.D.	D-28	5/24/41	7/21/41	8	10	44,933	7,866	1:80	1:160
W.E.K.	D-7-A	5/19/41	7/21/41	3	18	107,200	42,800	1:80	1:160
S.Z.	D-30-2	6/17/41	8/16/41	6	29	126,666	67	1:40	1:80
A.M.	D-30-1	6/17/41	8/16/41	6	29	103,333	11,666	1:320	1:1280
K.A.	D-29-2	7/17/41	9/5/41	24	13	82,000	20,800	—	—*
E.B.A.	D-30-1	7/14/41	9/5/41	11	28	25,833	4,266	—	—
E.D.C.	D-30-2	7/14/41	9/5/41	12	37	123,333	25,333	—	—
A.J.S.	D-30-1	7/17/41	8/25/41	11	17	40,400	29,000	—	—
J.P.S.	D-29-1	7/14/41	9/5/41	21	21	10,000	733	—	—
R.F.L.	D-7-A	4/18/41	8/19/41	9	26	20,266	133	1:40	1:160
W.W.P.	D-30-2	7/17/41	9/2/41	9	22	321,333	431,000	0	0
S.F.K.	D-7-A	4/30/41	9/2/41	12	34	249,333	30,660	—	—
J.M.M.	D-29-2	7/15/41	9/5/41	21	20	211,000	15,100	0	1:160
H.G.H.	D-30-2	7/16/41	9/5/41	10	31	214,600	26,200	—	—
W.G.T.	D.T.A.†	8/6/41	9/2/41	15	5	113,600	33,133	—	—

*Serum not available.
†Autogenous vaccine.

The most stable characteristic of any particular strain was its ability to produce acid, the pH attainable in acid-glucose broth being more or less constant when tested and retested. The smooth white convex type colony observed on tomato-agar plates usually possessed the greatest fermentative ability. The gray-

ish intermediate and rough type colonies were, in general, less acidogenic. It was also noted that the variant strains which developed from the so-called parent or normal forms were often associated with a reduction in fermentative and acid-producing power. The latter statement is not in agreement with Hadley, Bunting and Delves,[23] who state that certain of their dissociated forms produced as much acid and differed only slightly in fermentation reactions from those of the smooth, mother type.

In view of the heterogenicity of the oral lactobacilli and the wide range of variation, both cultural and biochemical, that may occur within any particular strain, we have made no attempt to classify these organisms into types or groups, as has been done by other investigators.

PRESENT INVESTIGATION

In a previous publication[28] on the bacteriology of carious dentin, our findings indicated that *L. acidophilus* has an important etiologic rôle in the carious process. By following a procedure that tended to eliminate the gross contaminating organisms from the surface of the cavity, we were able to demonstrate the infrequency of other bacterial types. This, together with the fact that active carious dentin has a high hydrogen-ion concentration, excludes the ordinary mouth streptococci, staphylococci and other local organisms as important agents, since these do not possess marked acidogenic or aciduric powers.

While we agree that there is a close correlation between the degree and the activity of the carious process and the number of lactobacilli present in the mouth, we have, because of inherent difficulties mentioned earlier, and others to be mentioned later, made no attempt in this investigation to study further the strains present in the saliva.

In the immunologic studies to be reported, the strains of *L. acidophilus* used were isolated from the carious dentin of extracted teeth. The bacteriologic method employed was as follows.

Procedure.—Extracted teeth with extensive carious lesions containing a large bulk of leathery decay were selected for study. Undermined enamel margins were broken down with chisels, care being exercised to avoid penetration of the dentin with the instrument. All superficial débris was carefully and thoroughly removed and the exposed surfaces of the cavity were sterilized with 95 per cent phenol. This was allowed to dry, the remaining superficial coagulated débris removed with sterile instruments and phenol applied as before.

The bulk of the carious dentin was then removed *en masse,* placed in a small sterile porcelain crucible and emulsified in 2 cc. of sterile physiologic sodium chloride solution. From this inoculum, serial cultures were made on the following media: tomato-agar plates (pH 5.1), serum-agar plates (pH 7.4), glucose-brain broth (pH 7.2) and tomato broth (pH 5.1). These cultures were incubated both aerobically and anaerobically, observations for growth being made at forty-eight and seventy-two hours and at subsequent intervals.

For the quantitative observations on the agar plates, 0.1 cc. of a 1:20 and of a 1:200 dilution of the original inoculum was usually employed. All anaerobic cultures in this investigation were incubated in a 10 per cent carbon dioxide environment.

Bacteriologic Findings.—The anaerobic cultures consistently gave a more luxurious growth with decidedly less tendency toward variant or dissociated forms. This was particularly noticeable with the subsequent platings from the broth cultures, as well as with other individual isolated strains. These observations on the appearance and the type of colony or colonies indicated that an aerobic environment was conducive to an associated change in the morphologic

and cultural appearance of *L. acidophilus*. Such changes may also be associated with a change in biochemical reactions or antigenic structure.[36] Accordingly, all the strains used in this study have been isolated under strict anaerobic conditions, and maintained on tomato-agar slants (pH 6.1) in the refrigerator, in order to preserve the original cultures without change until completion of these studies. With this method, all our cultures, except D-22-K, have remained constant in structure and colony form, observations having extended over a period of one year on several of the strains. Fermentation reactions (the test sugars adjusted to pH 6.1 with bromcresol green as indicator) have remained constant throughout the period for the majority of the strains.

Tomato-agar adjusted to pH 5.1 and pH 6.1 was selected as the most nearly ideal medium for subsequent growth observations, because it produced the maximum amount of growth with the least apparent dissociation, at the same time affording sufficient differentiation of closely allied strains of *L. acidophilus*. This selection resulted only after testing most of the commonly suggested culture media, which included tomato-agar, pH 6.1, casein digest-agar, glucose-sodium-oleate-agar, glucose-serum-agar, peptonized milk-agar, glucose-agar plus 1 per cent casein, milk digest-agar and trypsin digest-agar. While certain of these media provided excellent growth for *L. acidophilus*, they did not show sufficient colonial differentiation for the various strains studied. Tomato broth, pH 5.1 and 6.1, was used routinely in culturing the aciduric organisms in preference to acid-glucose broth. The organisms of single isolated colonies, which so often fail to grow in glucose broth, were usually recovered without difficulty in tomato broth.

In order to obtain a representative number of *L. acidophilus* strains for immunologic studies, the carious material from fourteen teeth was cultured. Examination of the serum-agar plates made for quantitative study showed the presence of streptococcal colonies in only two specimens, and then but few as compared to the lactobacilli. Brain broth cultures were likewise negative, except in the same two instances, confirming our previous findings relative to the infrequency of streptococci in carious dentin. Yeast-like organisms were not present in a single instance.

From this source, thirty-one strains of *L. acidophilus* were isolated on the tomato-agar plates. With slight modifications, three types of colonies were recognizable at from forty-eight to seventy-two hours. These may be described briefly as: (1) a large low convex white colony varying from 1 to 1.5 mm. or more in diameter, with an entire but slightly irregular undulate edge, the surface appearing smooth or slightly striated, with or without peripheral contouring; (2) a smooth white convex colony, about 1 mm. in diameter, and (3) a small grayish granular intermediate type of colony. To aid further in differentiation of *L. acidophilus* strains, the colonies should be observed under magnification. At from eighteen to twenty-four hours, individual colonies may be from smooth, granular or irregular to filamentous in outline, with a smooth, granular or rough veinous relief map surface, which is overgrown on subsequent cultivation, the colonial structure being obscured. Other minor changes in appearance may likewise be noted on viewing the colonies by transmitted light at later growth periods. The designation of the strains isolated in pure culture is recorded in Table 1.

IMMUNOLOGIC STUDIES

The immunologic approach to the problem of caries susceptibility or nonsusceptibility has, in our opinion, been the most neglected phase of investigation. The fact that certain persons can ingest

a wide variety of food containing carbohydrate in some form and remain free from carious lesions, while others, under the most drastic dietary control, remain susceptible, suggests the possibility of a primary protective principle. This substance appears to be present in the saliva and to manifest itself by inhibiting the growth and proliferation of *L. acidophilus*. That the saliva contains such an inhibitory factor has been demonstrated by Clough,[37, 38] Hine,[39] Bibby[40] and Hill.[41] Further, we have in our studies on saliva, at the Army Dental School, demonstrated such an antagonistic factor. Since the relationship between caries and some underlying causative condition appears to be associated with the presence or absence of *L. acidophilus* in the mouth, we have undertaken our immunologic studies with this specifically in mind.

The presence of agglutinins against *L. acidophilus* in the saliva of caries-free persons has been reported by McIntosh *et al.*[42] and Rosebury,[43] but in low concentration and as of questionable significance. Ross, Krasnow and Samet[44] report the presence of agglutinins in the saliva of rabbits following inoculation with *L. acidophilus* antigen.

Investigations by the Michigan group on the immunologic phase of dental caries have been more extensive. While not able to demonstrate the presence of *L. acidophilus* agglutinins in human saliva, Jay, Crowley, Hadley and Bunting[45] found such agglutinins in much higher titer in the serum of caries-free individuals than in the serum of the susceptible. Jay *et al.*[46] report that skin reactions to intradermal introduction of a filtrate prepared by pooling forty strains of *L. acidophilus* occurred more often in persons with active caries than in those free of caries and associated negative skin reactivity in the presence of serum agglutinins. A similarly prepared purified filtrate was found less specific than the non-purified. Subsequent injections of filtrate (purified) into caries-susceptible individuals indicated that it was not antigenic, as shown by skin sensitivity tests. In the same report, two patients with positive skin reactions who had received repeated inoculations with a polyvalent *L. acidophilus* vaccine were successfully desensitized. This resulting negative skin reaction was accompanied in both instances by the appearance of *L. acidophilus* agglutinins in the blood serum.

In our immunologic approach to the problem of dental caries, we had as our ultimate aim the development of a suitable *L. acidophilus* vaccine for human immunization, devoid of the abscess-producing properties encountered by Jay *et al.*[45, 46]

Consideration of our early strains indicated that we were not dealing with homologous organisms, but strains which differed in one or more characteristics. Since typhoid vaccine studies[47] at the Army Medical School showed that different strains of *E. typhosa* varied in virulence, antigenic properties and immunogenic potency, we proceeded to immunize normal rabbits with the cultures recorded in Table 1, except D-8-F, D-12-C, D-17-A, D-17-B, D-28-C and D-29-1, in order to select those strains which showed the greatest immunogenic possibilities.

AGGLUTINATION REACTIONS

Antigens were prepared for each strain by growing the culture anaerobically on tomato-agar slants pH 6.1. After forty-eight hours of incubation, the growth was recovered in buffered physiologic sodium chloride solution (pH 7.2) and diluted so that 1 cc. contained 2,400,000,000 bacteria, as determined by the McFarland nephelometer. Sufficient antigen was prepared at one time for the immunization procedure and stored in the refrigerator. Rabbits were immunized by intravenous injection into the marginal ear vein of

2 cc. of the prepared antigen every third day until an agglutination titer of 1:2,560 or higher was obtained. From 20 to 25 cc. of antigen was usually sufficient, the animal being bled from the heart on the seventh to tenth day following the last inoculation.

Stock agglutination antigens were similarly prepared from anaerobic tomato-agar cultures, suspending the growth in buffered physiologic sodium chloride solution containing 0.5 per cent phenol. These antigens, for all strains, were standardized to contain approximately 900,000,000 organisms per cubic centimeter. By this method, with the exception of strain D-29-1 and a slight tendency in the group 3 strains, we experienced no difficulty in preparing satisfactory agglutination antigens free from troublesome granularity. Acid broth, while providing excellent growth for *L. acidophilus,* proved unsatisfactory for use in agglutination tests because of marked acidity. Even when broth cultures were centrifuged and the sediment was washed to free it from acid, owing to the inherent character of most strains as regards a granular growth phase in broth, the resuspended antigens exhibited a decided tendency to agglutinate spontaneously.

Twenty-four antiserums were tested against antigens prepared from the dentin strains, except D-8-F, D-12-C, D-28-C and D-29-1. In the agglutination procedure, a buffered saline solution was used throughout the test, the serum dilution ranging from 1:40 to 1:5,120. The tubes were incubated overnight in a water bath at 37° C., and subsequently placed in the refrigerator twenty-four hours before the results were recorded.

From analysis of the data on the cross agglutination tests, it was apparent that the majority of the strains used in this study showed a more or less close serologic relationship to one another. However, peculiarities were observed in the reactions of many of these; for example, two strains could be chosen either one of which was readily agglutinated by the antiserum of the other, but did not necessarily continue to show this antigenic similarity when tested against other strains. Typical of such a duet of cultures are strains D-13-C and D-14-A: D-13-C serum agglutinated D-14-A organisms in a dilution of 1:1,280, and the serum of strain D-14-A agglutinated D-13-C organisms in a dilution of 1:640, but when the antiserums of these two strains were titrated against twenty-three other cultures of *L. acidophilus,* in only six instances did they react alike. In six instances, they differed by one dilution; against six organisms, there was a widely divergent reaction, and, in the remaining cases, there was complete disagreement.

The agglutination reactions with the antiserums of strains D-22-K and D-26-D, representative strains of Group 3 organisms, showed these organisms to be serologically distinct from Group 1 and Group 2 strains. No further immunologic experimentation was attempted with this group of organisms, because of their low acidogenic property and their apparent infrequency in dental caries.

It can only be concluded, from such results, that the antigenic structure of *L. acidophilus* is extremely complex and the number of antigenic components must be very great. Identification of the antigenic components of this group of organisms, similar to that which has been made of the salmonella group, seems to be indicated before much can be accomplished by serologic studies of the lactobacilli.

STANDARDIZATION OF VACCINE*

Before proceeding with human experimentation, we selected a number of *L. acidophilus* strains, prepared vaccines with both heat-killed and viable cultures, and inoculated rabbits and guinea-pigs

*Standardization of vaccine for human vaccination is discussed under the heading of "Human Experimentation."

subcutaneously to determine the degree of antigenic response by this route. These preparations, after a few inoculations, were discontinued because of the severe local abscesses formed. Similar complications have been reported by Jay *et al.*,[45, 46] not only in rabbits, but also in human immunization experiments. In these studies, it was reported that the rough cultures produced the subcutaneous abscesses, while the smooth did not. To gain further information on the nature of the abscess-producing factor, they inoculated a series of guinea-pigs subcutaneously with rough and smooth colony *L. acidophilus* vaccine. Histologic studies relative to the cellular reaction in these animals at the site of inoculation at different time intervals indicated that the smooth organisms were easily phagocytized, while, with the rough organisms, there was delayed phagocytosis, affording a partial explanation of the process.

In view of the findings mentioned above, to determine the presence or absence of an abscess producing factor in each strain listed in Table 1, we prepared vaccines of different concentrations, and inoculated animals subcutaneously. All strains exhibited this property, the severity of the reaction of any given strain being proportional to the amount and concentration of the vaccine used. Corresponding lesions in guinea-pigs were usually less marked than those in rabbits. Cultures prepared from the caseous purulent lesions produced by the heat-killed vaccines were always sterile.

Efforts directed toward the removal of this abscess-producing factor from *L. acidophilus* vaccine by various means have not been successful. Undenatured bacterial antigens were prepared by Krueger's method[48] from strains D-7-S, D-9, D-22-D-1 and D-22-K by grinding in a ball mill.[49] In this procedure, difficulty was encountered in bringing about a disintegration of the bacterial cells. With the ball mill rotating approximately 100 times per minute, from 3 to 5 days of continual grinding was required to extract from 20 to 25 per cent of the total bacterial nitrogen. Subsequent subcutaneous injections into rabbits and guinea-pigs of these fractional intracellular extracts still revealed the presence of the abscess-producing factor, even though the preparations were sterile and free of bacterial cells. From these findings, it would appear that the irritating factor in the vaccine is not due to a failure of phagocytic activity, but rather to some inherent chemical irritating constituent of the bacterial cell. Likewise, the passage of a number of selected strains through egg embryos, and other attempted procedures, did not modify this characteristic of the vaccine.

During these studies, it was observed that if the vaccine was sufficiently diluted, multiple subcutaneous inoculations could be made without the previously described local reaction, particularly in the guinea-pig. Following a number of such inoculations, subsequent serologic studies showed that all the test organisms were antigenic. Since the rabbit was more susceptible than the guinea-pig to subcutaneous injections of *L. acidophilus* vaccine, the guinea-pig was used for standardization of vaccine. King and Rettger,[50] in a recent report, state that the oral lactobacilli could not be employed in certain skin tests on rabbits because of pseudoreactions.

HUMAN EXPERIMENTATION

Vaccines were prepared from selected strains, heat killed at 56° C., maintained for one hour, and preserved with 0.5 per cent phenol. Each suspension was then standardized so that 1 cc. contained approximately 450,000,000 organisms, as determined by the McFarland nephelometer. This concentration of vaccine usually caused little or no reaction when 0.5 cc. was injected subcutaneously into guinea-pigs. In preliminary intradermal

human tests, it likewise caused little or no reaction. This dilution of vaccine was designated dilute antigen, while double this concentration of organisms was designated concentrated antigen. Before use, these antigens were tested for sterility and checked for toxicity in suitable animals, which were observed for a period of ten days.

Twenty caries-susceptible patients were included in this study. (Owing to the temporary duty status of the majority of subjects under study, we were limited to an observation period of approximately ten weeks.) These were enlisted men, eating at the soldiers' mess, except R.M.L. and J.M.M. No changes in dietary routine were instituted during the course of treatment. Prior to immunization, an estimation of the average number of lactobacilli per cubic centimeter of saliva was made from three tomato-agar (pH 5.1) platings, ranging over a period of one week or more. Lactobacilli counts were continued at weekly intervals during the course of immunization, and an average count was again obtained from three successive platings after termination of treatment. Stimulated saliva was always collected the same time of day for each individual, approximately three and one-half hours after breakfast, and plated in dilutions of 1:20 and 1:200. In many of these cases, we were able to obtain serum before and after treatment.

Each patient received the vaccine by intracutaneous administration, in amounts of 0.1 cc. at a single site of inoculation. Longfellow and Luippold, in a recent report[51] on typhoid vaccine studies, found that revaccination with a single dose of 0.1 cc. of vaccine intracutaneously administered was as effective in renewing immunity to typhoid fever as a single dose of 0.5 cc. of vaccine subcutaneously administered. They also stated that the reactions to the intracutaneous administration of vaccine were less severe.

In this investigation, the first intracutaneous injection was with 0.1 cc. of diluted antigen. The area of inoculation was observed as to the degree of skin reactivity at twenty-four hours, forty-eight hours and subsequent times. If the local reaction remained negative, or was only slight or mild in character following several successive administrations, the vaccine was changed to the concentrated form. The time interval between injections varied somewhat with different cases. First, we administered the vaccine every five days, while, in our later cases, the procedure was changed to three-day intervals. We also instituted multiple injections, in the latter cases, following the initial dose. In these cases, four 0.1 cc. injections constituted the maximum amount of antigen used for any individual at one time.

The skin reactions in the majority of the cases were essentially negative. Occasionally, the local site of inoculation showed slight reddening and induration for from twenty-four to forty-eight hours, confined to the area of the bleb produced by the vaccine, which gradually subsided with an area of discoloration persisting for several days or weeks. In no instance did the patients experience axillary adenopathy or systemic discomfort, the area of involvement remaining strictly localized. One patient (W.J.T.) showed a local skin reaction to all the stock vaccines employed, induration, extending to abscess formation in from four to five days, always following at the site of inoculation. These lesions were from 5 to 6 mm. in diameter and painless (except for a slight itching sensation), and they persisted for several days, after which they gradually subsided. In view of the local reactivity of the patient to selected stock vaccines, we prepared autogenous vaccines from two *L. acidophilus* strains isolated anaerobically from the saliva. On subsequent tests, one of these strains (D-T-A) was found to be, in this individ-

ual, free of the abscess-producing factor.

The data on the human vaccination experiments are given in Table 2. The quantitative-bacteriologic estimations represent the average of three counts made on three different days within a period of from seven to fourteen days prior to vaccination, and from four to ten days subsequent to the vaccination procedure. These counts indicate differences in number of organisms after vaccination as compared to the counts before vaccination. This difference, although varying with different persons, was consistently a trend toward reduction of numbers of *L. acidophilus* in the mouths of vaccinated persons in all cases except one. To what extent closer attention to oral hygiene may have influenced this reduction in numbers of lactobacilli, it is difficult to say. Although a controlled oral hygiene program was not carried out, these patients were instructed to brush the teeth each morning after breakfast in order to eliminate possible fluctuations in the plate counts. At the conclusion of the experiment, some of the patients stated that they had paid closer attention to oral hygiene, while others indicated that there had been no change in their usual routine. One patient (H.G.H.) followed a strict hygienic program for six weeks prior to vaccination, but showed no apparent change in *L. acidophilus* count. Another patient (J.P.S.) habitually neglected his mouth, seldom using a toothbrush, and yet, after vaccination, showed an appreciable lowering of the number of these organisms.

In view of the variation in antigenic material used for vaccination and in the amounts of this material, no analysis of the results of the agglutination tests has been attempted. It can be seen, however, that, in most instances, vaccination resulted in increase of the agglutinin titer. It is obvious that if this investigation is to be repeated or renewed, more constants must be introduced, in order to actually evaluate the results of this quantitative and serologic study.

SUMMARY

Studies were made of the antigenic behavior of twenty-four strains of *L. acidophilus* recovered from carious dentin, and of the quantitative results of vaccination with *L. acidophilus* bacterin on this organism in the mouth.

The antigenic composition of members of this group of organisms presents a bewildering complexity as determined by cross-agglutination tests.

Vaccination of humans with vaccines prepared with strains of *L. acidophilus* isolated from carious dentin seemed to stimulate the production of a substance having growth inhibitory properties toward *L. acidophilus* in the mouth, as evidenced by a reduction in numbers of these organisms in the mouths of nineteen of twenty patients so vaccinated. Accompanying this reduction in numbers of lactobacilli, there was usually a corresponding increase in the agglutinin titer.

Because of the small number of cases under observation in this study, we hesitate to draw any conclusions on the basis of results obtained. It is evident, however, that further studies of this and related problems are indicated.

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AN OBSTETRICIAN LOOKS AT DENTISTRY

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IF we begin with the premise that there is a kindred interest between obstetrics and dentistry, we might ask the dentist to take a quick glance at obstetrics in order to obtain a proper perspective of this problem.

About 2,000,000 babies are born in the United States every year, or an average of one baby every fourteen seconds. In the Territory of Hawaii, there are approximately 10,000 births per annum, or one baby every hour. Half of these babies are born in families with an income level of $1,000 or less; which means that they are born to families whose income is such as to make them indigent as regards obtaining adequate medical services through private channels. This indicates that maternity care is a community problem, but it is only in recent years that we have come to accept it as such.

Until recently, there has probably been no other branch of the medical arts which has bogged down so deeply in unscientific mire as has obstetrics. This history of obstetrics is a perfect maze of religious prejudices, of monopolies by midwives, of aloof attitudes of the medical profession and of beliefs that since confinement is a natural process, it can rightfully be relegated to the back bedroom with "Aunt Mary" in charge. It

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is only in the last century that the scientific world has come to appreciate the fact that gestation is a very complex process, beset by myriads of hazards, the understanding of which requires a lifetime of study. Much of this change has been effected by the attitude of the public. When each year there is in America a needless loss of thousands of mothers and babies as a result of unscientific obstetrical practice, the expectant mother of today is justified in demanding better care. Among the civilized nations, America has for years stood very near the bottom of the list in its infant and maternal mortality rates. Is it any wonder, then, that the trend is more and more toward a scientific approach to obstetrics as an individual and as a community problem?

Even the medical profession has looked upon obstetrics as the stepchild of surgery, and when it failed to assume stewardship over the community aspects of maternal welfare, it was only natural that other agencies should step in to silence a public outcry against old and obsolete attitudes. Today, governmental agencies have assumed a distinct leadership in this field of public health service. Today, our federal and local governments are pouring thousands of dollars into a nation-wide program, trying to offer the expectant mother and her baby a fair deal. In Hawaii, the Bureau of Maternal and Child Health, which is a part of the board of health, administers the local program. We have nearly 200 obstetrical and pediatric clinics throughout the Territory, and we are spending $65,000 a year on this community-wide program, most of the funds coming from federal sources. The results of such an extensive public program are just what might be expected—a continuous lowering of maternal and infant death rates. Ten years ago, nearly 50 per cent of deliveries in Hawaii were unattended. Today, 80 per cent take place in carefully supervised hospitals, with physicians in attendance, while unattended and midwife deliveries are rapidly decreasing. Today, the trend is even more toward delivery by specialists in obstetrics and in hospitals which offer the maximum of facilities, comfort and safeguards. Verily, obstetrics has come to the point of accepting the fact that every expectant mother is deserving of the kindly and scientific consideration that the more complex medical and surgical cases receive; and I predict even further trends toward specialization and scientific approach to the problems of the expectant mother.

"FOR EVERY BABY, A TOOTH"

For years, it has been an accepted dogma that when a woman becomes pregnant, her teeth, and in fact her whole system, suffer seriously. Today, we no longer believe that this need be true, and we are doing our utmost to apply the modern knowledge of nutrition, of biochemistry and of mineral metabolism to the complex functional problems of physiology in pregnancy, in order to prevent the ravages of suboptimal health during the period of gestation.

In trying to solve such problems, the obstetrician and the dentist have had to pool their resources and ability. And it has been gratifying to see the increasing sympathetic understanding of the dental problem in obstetrics. It is a sad commentary, however, that, in this community, there are still too many dentists who cling to the tradition that no dental treatment should be undertaken when a woman is pregnant. This belief is certainly not founded on fact, since it has so consistently been proved that abortion rarely, if ever, results from dental procedures. The obstetrician of today makes a dental examination part of his routine prenatal examination, insisting that it is even more important to have defects corrected in the pregnant than in the non-pregnant state. Yet how often the expectant mother returns to the phy-

sician's office with the statement, "Doctor, I don't know what to do. I went to my dentist, but he will not treat my teeth because I am pregnant." Are we fair when we refer this patient to another dentist, who sees eye to eye with us and who attempts to practice 1941 rather than 1841 methods?

PROPHYLAXIS

When a woman becomes pregnant, the integrity of every organ and every function of her body is tested severely. If we are going to assume that it is easier to keep out of trouble than it is to get out of trouble, we must know the whole organism and not simply the uterus and the fetus. In respect to dentistry, we are in agreement with the old Chinese custom of reckoning a child's age from conception rather than from birth, and it really is rather stupid to consider a child to be at the zero age at the moment of birth, when actually it has been growing for nine months. If we are going to offer the child prophylaxis against dental defects, we must begin early in pregnancy because it has been demonstrated that, under unfavorable circumstances, a child may have considerable dental defects at birth, even six months or more before the teeth are due to erupt.[1]

This is no place to try to assign the cause or causes of dental caries. We have heard the arguments about the rôle of inheritance, of the acid-base balance, of nutrition, of mineral metabolism, including the newer ideas of the "trace metals," the poi and sweet potato diet, the importance of dentifrices, as well as the virtues of a particular shape of toothbrush. All of this leads us to believe that the chapter on this subject has not yet been written and, until further proofs are produced, the obstetrician will continue to attack the problem of prophylaxis for both mother and child in the following practical ways:

1. *An Adequate Diet.*—The Bible says that man cannot live by bread alone and that is true for the pregnant woman. An adequate diet not only must include sufficient calories for the mother's increased metabolic needs, but also must represent a sensible balance among the five essentials: fats, carbohydrates, proteins, minerals and vitamins. That the ratio of these factors changes in various stages of pregnancy need but be mentioned here. It has taken long and hard efforts to teach the fundamentals of an adequate diet to the pregnant woman, but one evidence that we are succeeding is shown by the fact that today it is indeed rare to see a pregnant woman with beriberi, whereas it was a common cause of maternal morbidity and fetal death in the community only fifteen years ago. Where an adequate program of prophylaxis has been followed, it is gratifying to the obstetrician not only to see the patient in health throughout pregnancy, but also to note that the dental condition is just as good after confinement as in the first stage of pregnancy. Because we have often made this observation, we firmly believe that an adequate diet helps to prevent the loss of a tooth "for every baby."

2. *Adequate Calcium and Iron.*—The chemistry and biochemistry of calcium is too well known to need discussion here except to point out that pregnant women seldom show a deviation in blood calcium concentration from the accepted normal of 9-11 mg. per hundred cubic centimeters except in the stage of lactation.[2, 3, 4] Apparently, calcium deficiency is not *per se* the cause of dental caries, then, although we do not yet know what minor degrees of hypocalcemia may cause a rapid withdrawal of calcium from deposits in the body. In order to insure an adequate available supply of calcium, we routinely give calcium by mouth, combined with adequate amounts of the essential vitamins.

Iron is not directly involved in dental prophylaxis, but since iron deficiency and the secondary anemia of pregnancy

are almost universal, iron is almost routinely prescribed for the pregnant woman. It can be assumed that disturbances in hemoglobin content probably reflect disturbed metabolism and, therefore, iron deficiency may be of greater importance than we have believed.

3. *Parathyroid Sufficiency.*—Since the parathyroid glands regulate calcium metabolism, whether they function adequately must be known. If blood calcium levels drop to 8 mg. or lower, we suspect that grave deficiencies of parathyroid secretion exist, and unless they are corrected, the patient faces the prospect of a marked disturbance of calcium metabolism, as indicated by tetany or possibly even osteomalacia.

4. *Vitamin D and Ultraviolet Rays.*—That vitamin D and ultraviolet rays in some way act as a catalyst in the chemistry of calcium metabolism is an accepted fact. Vitamin D is included in the dietary and usually is also given in the form of cod-liver oil or viosterol. In this land of sunshine, we prescribe ultraviolet light by the simple admonition to take a daily walk in the sunshine.

5. *Vitamins C and A.*—There are theories regarding the rôle of vitamin C in dental caries, but it is not clearly understood. The lowly guava is a rich and inexpensive source of vitamin C, and we extoll its virtues in our dietary advice. Citrus fruits and leafy vegetables are also recommended, but the fact that milk is a good source of vitamin C only if consumed immediately after being drawn from the cow disposes of the old idea that a pregnant woman must drink 2 quarts of milk a day.

There is increasing evidence that vitamin A is also more important in dental health than we formerly believed, and must be included in the mother's dietary. An ordinary intake of yellow fruits and vegetables usually provides enough of this vitamin, but when the patient has an aversion to carrots and papaya, we substitute other sources of vitamin A or provide it artificially.

THERAPEUTICS

Careful study[5] of the better class of private patients shows that about 15 per cent of pregnant women have one or more apical abscesses. I know of no such studies among our thousands of clinic patients here, but, from observation, I can affirm that it is the exception rather than the rule to find in this group a patient without easily demonstrable caries.

In accepting these truths, why should the obstetrician give them any concern other than to reduce discomfort from toothache? While we do not believe that all obstetrical complications are of oral origin, we accept dental sepsis as frequently the background of several important complications, and because of this correlation, we have the right to insist on its elimination early in pregnancy. The complications referred to are:

1. *Eclamptogenic Toxemia.*—While all of the causes of this dreaded complication are not yet understood, there is evidence in some cases that a focus of infection is the direct cause. Until we know more about the treatment of convulsions in pregnancy, we must continue to emphasize prevention, and that includes eradication of foci of infection.

2. *Pyelitis.*—Urinary stream infections are common in pregnancy, and at times it is difficult to eliminate them. Urologists and obstetricians agree that these infections are often blood borne and can often be traced directly to dental sepsis.

3. *Abortion.*—About one pregnancy in five terminates in abortion, the cause of which is often not even investigated. Microscopic studies[6] often reveal a close relationship between foci of infection and septic infarcts in the placenta, which precipitated the abortion.

4. *Phlebitis.*—This is always an embarrassing complication, with long hospi-

talization and a marked tendency to recurrence when once established. The focus of infection is not always of pelvic origin, often being traced to dental sepsis.

It is hardly necessary to repeat that the obstetrician has every right to expect the closest cooperation of the dentist in evaluating the need for dental treatment in the pregnant woman.

PAINLESS CHILDBIRTH AND PAINLESS DENTISTRY

The obstetrician and the dentist have a kindred problem in performing their services as painlessly as possible. Much research in anesthetic methods is resulting in greater comfort as well as safety; still we are not satisfied, because we have not yet found something which is entirely safe and which does not have its drawbacks. Our efforts must be made with great care because we are dealing with two lives, and the unborn baby is very sensitive to most drugs that kill pain.

I have often wondered about the future of painless dentistry. Personal experiences as a dental patient have convinced me that procaine leaves much to be desired. In questioning women patients regarding their reluctance to visit the dentist, I find them as fearful of the needle and of the hypertensive effects of adrenalin as they are of other painful dental procedures. Is it possible that if the cyclotron can break up the atom and give us radio-active substances, other forms of electrical energy can be used to block a nerve temporarily? The x-rays can help us visualize the tooth structure: why can't "q-rays" block out its pain perception?

Perhaps I am violating propriety by asking such critical questions of another profession. However, since we have taken a fleeting look at obstetrical practice, and have seen how it has been brought out of the mire of prejudice by research and clear thinking, is it not wise for us to take a careful inventory of present dental methods and question the wisdom of giving so much time to the simple mechanics of the art and failing to inquire into the major problem of underlying causes? Has not the obstetrician the right to enlist the superior training of the dentist in helping not only to salvage the mother's teeth, but also to see that the future citizen *in utero* gets nine months of sound dental prophylaxis before he comes into the world?

CONCLUSIONS

1. The statement "for every baby, a tooth" is no longer held tenable by the modern obstetrician.

2. Dental prophylaxis should begin early in pregnancy since a child at birth has already arrived at the age of 9 months dentally and physically.

3. Further research in the field of dentistry and a closer liaison between dentist and obstetrician are imperative.

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THE OPTIMUM TIME FOR ORTHODONTIC TREATMENT

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THE time when orthodontic treatment should be started has always been a bothersome question to orthodontists. If the prevailing practice is to be taken as the answer, the time to start treatment is when the patient arrives at the orthodontist's office and the necessary arrangements have been made. In the light of modern progress, however, such practices do not seem to be very satisfactory. The reason, though obvious, is usually obscured by conditions which happen to follow. Because most folks jump first and think last, it is quite natural to become confused by the sequence of events. There is no apology needed in admitting that independence in existence rests upon economic security. As professional people, we depend on patients coming to us for the services that we are able to render. Our patients, to be sure, are only those for whom we do something: do it and do the best we can and know how. The first anxiety is to get started.

The pathways of orthodontia have as yet not been streamlined. There are still unexpected, unperceivable, unpredictable and uncontrollable twists and turns to be encountered on the way. Some of us are at times liable to become confused. When this happens, after getting started, the regrettable error usually made is just to keep going and hoping for the best. In the end, there is a trail of events left behind which adds to either the credit or the debit in the score of experience. Of course, we learn by experience; but not so much as is inferred. Since the ultimate result in orthodontic endeavor varies with the individual and the experience, there is a notable lack of uniform knowledge of what it is all about. The general trend of beginning orthodontic treatment when the patient appears may be taken as a starting point. Arguments are advanced which seem to be convincing enough, but they are often contradictory too. It is commonly agreed, for instance, that, in the case of very young patients, early treatment is more advantageous and of greater benefit than later treatment. But it is also argued and with equal force that adult patients can be treated with satisfactory results even then. Every dentist and orthodontist is acquainted with these arguments. Their frequency and abundance render it needless to cite specific examples.

It is just because of these arguments that there is some confusion about the situation as a whole. The trouble, as it looks to me, is that decisions about the time for orthodontic treatment are often influenced by circumstances which have two implications. One is professional achievement; the other, financial gain. Even if a discussion of this sort is confined to merits of achievement alone, it is at once clear that the topic presents a problem of the first order in the practice of orthodontia. To deal with it in

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an understandable way, I shall try to answer just three queries:

1. What are the aims and qualifications in orthodontic practice?

2. What is indicated by the proof of actual results gathered from orthodontic practice?

in orthodontic practice is the restoration to normal occlusion of dentitions that are in malocclusion. This definition should be agreed to by every one acquainted with orthodontic practice. Moreover, since the dentitions of orthodontists' patients consist of two sets of

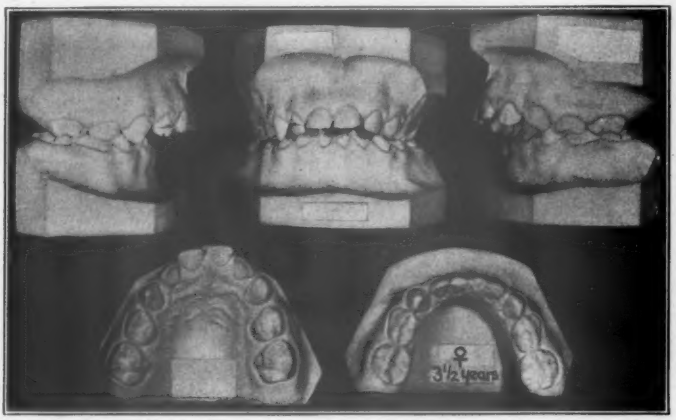

Fig. 1.—Casts of deciduous dentition in Class II, Division 1 malocclusion, when orthodontic treatment was begun, in girl 3½ years old.

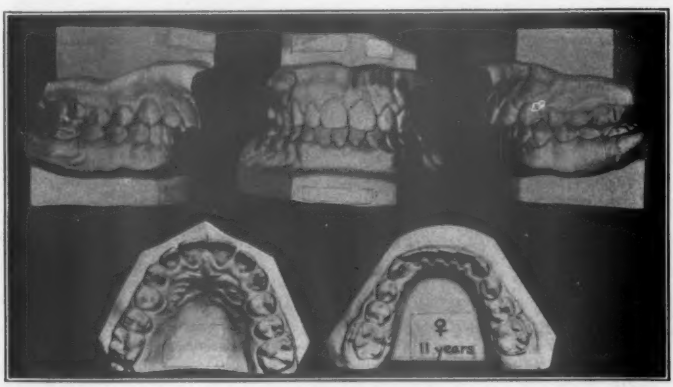

Fig. 2.—Casts of permanent dentition of girl in Figure 1, at 11 years. The occlusion is still Class II, Division 1. Treatment continued.

3. What, in my experience, points to the solution of the time problem in orthodontic treatment?

1. What are the aims and qualifications in orthodontic practice? The aim

teeth, it is of importance to be particular as to which one is meant. The definition is not very clear. When reference is made to correction of malocclusion, it is taken for granted that the end-result

expected is in the permanent dentition. But in starting orthodontic treatment of very young patients, the permanent teeth are as yet not present. Under such circumstances, the aim of orthodontic treatment is not judged by conditions prevailing at the time of beginning it, but rather predicted on premises that are transitional and have no part in the end. On this account, it is of primary importance to know exactly not only the details of occlusion, but also the sequence of events, in the course of development, beginning with the deciduous and culminating in the permanent dentition.

Of equal importance, then, are the ability and skill needed in making and handling the mechanical devices used for the purpose of gaining desired results. But since minute changes in position and relationship of the teeth follow immediately upon adjustment of appliances, keen observation and precise discrimination are essential to guard against missteps and to guide in the progress of treatment. Moreover, to avoid unobserv-

Fig. 3.—Casts of deciduous dentition when orthodontic treatment was begun, in girl 5 years old.

Fig. 4.—Casts of permanent dentition of girl in Figure 3, at 16 years. Malocclusion was still being treated.

able pitfalls, the traumatic effect of mechanical devices upon living tissues is at no time to be overlooked. Heeding scrupulously the warnings of Noyes,[1] Oppenheim[2, 3, 4] and Ketcham[5] is but a safeguard in avoiding damage to the teeth and to the tissues surrounding them. Finally, to gain the end in the successful completion of orthodontic treatment and be assured of permanency in the result requires determination not to let up and confidence in one's ability to achieve—qualifications without which orthodontic practice should not be undertaken.

2. *What is indicated by the proof of actual results gathered from orthodontic practice?* The answer to this question is best given in the form of the popular approach to the solution of the time problem in orthodontic achievement. It is for instance, most ardently hoped and frequently attempted to intercept troublesome occlusal conditions in their

Fig. 5.—Casts of mixed dentition in Class I malocclusion when orthodontic treatment was begun, in boy 9 years old.

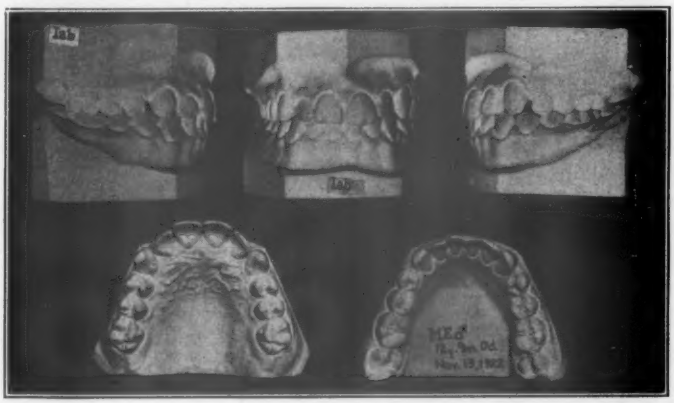

Fig. 6.—Casts of permanent dentition of boy in Figure 5, at 12 years 9 months. The lower second molars are erupting, the upper not yet present.

earliest manifestations. With confidence in his own skill and assurance of the effectiveness and efficiency of mechanical devices, the orthodontist's ambition is to prevent severe cases of malocclusion by intercepting them in their simplest form and at the very beginning. It was quickly and the result should logically be more satisfactory.

The greatest protagonist of this theory was E. A. Bogue, who maintained that "if a child has competent professional care up to the age of six, he can be almost guaranteed against serious oral

Fig. 7.—Casts of permanent dentition of boy in Figures 5 and 6, at 14 years 2½ months. The upper second molars are erupting, the left in buccal occlusion.

Fig. 8.—Casts of permanent dentition of boy in Figures 5-7, at 17 years. The second molars are fully erupted and in normal occlusion.

believed long ago and, as far as I am aware, is believed even now, that the younger the patient, the more plastic the tissues; and, consequently, that the teeth move more readily, the job is done more troubles during life."[6] Bogue also believed that the result of orthodontic treatment is not confined to teeth alone, but also implied "a well-developed head, nose and chest, with at least satisfactory

physical vigor." Accordingly, he insisted that orthodontic achievements "are the greatest guarantees of health, intelligence and efficiency that can be given any human being." In his anxiety to aid mankind, Bogue started orthodontic treatment as early as possible. He prided himself on having started treatment of some cases at 3½ years of age. Some of these patients, to whom I had access, were still wearing appliances at the age of 20 years.

During the first quarter of this century, it was quite fashionable to start orthodontic treatment early—the earlier, the better. Orthodontists vied with each other. One tried to outdo the other. Anyway, 3½ years of age was a pretty good record for an early start. As it looks now, there is some doubt about the good of it. There is still considerable lack of agreement on the significance of the early start and whether such practice is to be commended or condemned.

Fig. 9.—Casts of dentition at optimum stage of development in Class II, Division 1 subdivision malocclusion, in girl 11 years 8½ months old.

Fig. 10.—Casts of dentition of girl in Figure 9, after the completion of active treatment at 12 years 5½ months.

Judging from the rapid gain in popularity then and its prevalence now, it seems that commendation is the prevailing order. I know of no better evidence in favor of early treatment than the all too glaring publicity appearing so profusely in our popular magazines today.

jectionable features. One is that in the treatment of cases which were started early, the end-result to be gained was invariably overlooked; the other, that the stretch of time to be consumed in gaining the end was entirely ignored. I wonder whether those preaching early

Fig. 11.—Casts of dentition in Class II, Division 2 malocclusion when orthodontic treatment was begun, in girl 12 years old.

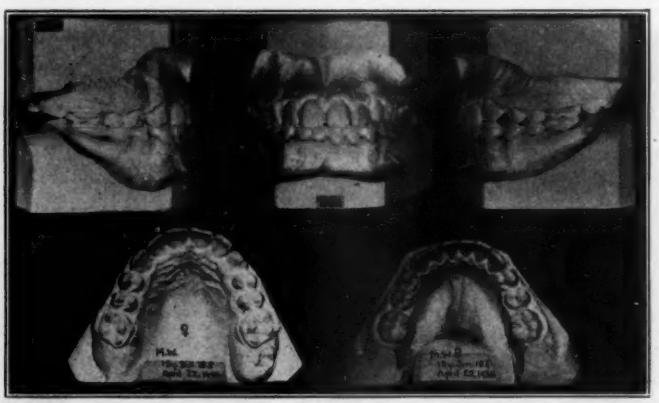

Fig. 12.—Casts of dentition of girl in Figure 11, after completion of active treatment at 13 years 3½ months.

There is, however, some available evidence which is not so favorable. It is not so glaring and not so profuse, but very convincing. This evidence is derived from actual experience in practice, and, as it appears, there are at least two ob-

treatment and preventive measures today are sufficiently mindful of the injuries to the teeth and to the surrounding tissues caused by long periods of treatment.

It is my conviction that, in so far as orthodontic treatment is concerned, there

is more anxiety about starting than about stopping or refraining. What is often overlooked is that early treatment once started, whether active or preventive, cannot be stopped until the goal is reached, if it is to be of any benefit. it occurs in the deciduous teeth, does not improve the occlusion of the permanent dentition. This point may be proved by just a few examples that have been taken from a large collection of cases treated by those who believe in starting early.

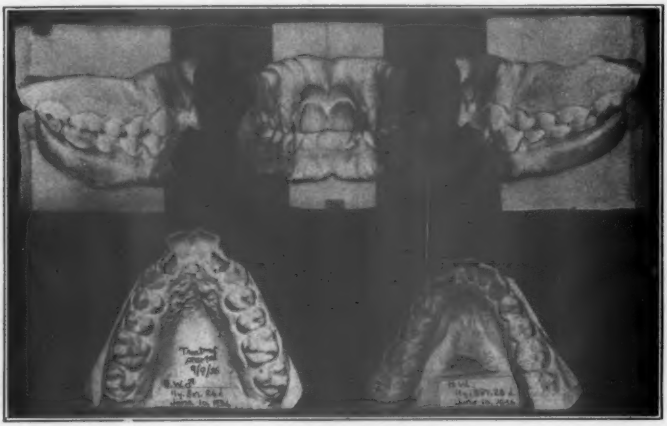

Fig. 13.—Casts of dentition in Class II, Division 1 malocclusion when orthodontic treatment was begun, in boy, 11 years 9 months old.

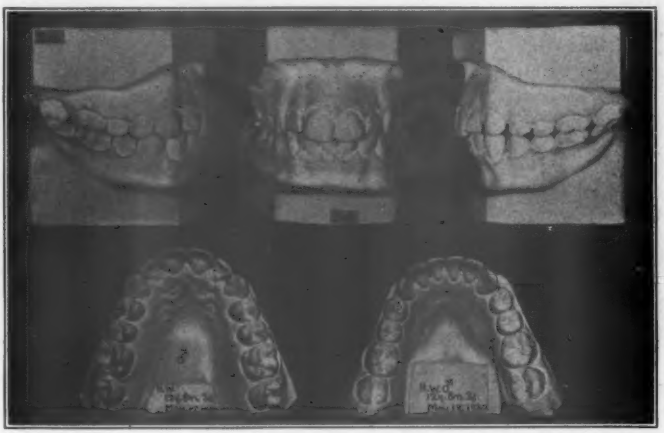

Fig. 14.—Casts of dentition of boy in Figure 13, after completion of active treatment, eight months later.

The goal is to establish normal occlusion —not just temporarily but permanently. There is abundant evidence now available that tinkering with malocclusion, as

In Figure 1 are shown the casts of the dentition of a child $3\frac{1}{2}$ years of age. The dentition, as will be noted, is in Class II, Division 1, malocclusion and the teeth

are deciduous. Beyond acknowledging that malocclusion exists, nothing else should, in my estimation, be done at this stage of development. It has been repeatedly shown that cases treated at this time have to be re-treated later on. This case, however, was not in my care. It was in the care of another and a very permanent molars. It should be noted that there are remnants of orthodontic appliances still present on some of the teeth, indicating that treatment is being carried on. It should also be noted that the occlusion is still in Class II, Division 1. In the meantime, the patient reached the age of 11 years, the change in denti-

Fig. 15.—Casts of deciduous dentition, plus lower right permanent first molar, in Class III malocclusion, in girl 5 years 11 months old.

Fig. 16.—Casts of dentition of girl in Figure 15, at 6 years 2½ months. There was no treatment.

competent orthodontist, who was of the opinion that treatment should be started at once. Figure 2 shows the casts of the dentition of the same child after all the deciduous teeth were shed and all their permanent successors had erupted, but before the appearance of the second tion from that shown in Figure 1 to that in Figure 2 requiring seven and a half years. It is of significance that the end in orthodontic treatment, as shown in this illustration, has as yet not been gained.

In Figure 3 are shown the casts of the

deciduous dentition of another child, aged 5 years. The occlusion had apparently been interpreted as malocclusion and treatment started at once. This patient came to me for an opinion later on. The casts of the dentition at that time are shown in Figure 4. In this case too, the presence of bands on all permanent first molar teeth indicates that treatment is being continued. The dentition, as shown in this illustration, has changed from the deciduous to the permanent. The occlusion is, in my estimation, not as good as it was originally. The age is now 16 years. This means that eleven years had already been given up to orthodontic treatment and the end was not yet attained.

The inference to be drawn from these two cases is that, since treatment was carried out by competent orthodontists, there was no question as to ability. Since the objective had not yet been gained, how much longer would it be advisable to continue with the treatment? Is the length of time required to gain an orthodontic end to be ignored entirely? It would seem to me that, in an attempt to

Fig. 17.—Casts of dentition of girl in Figure 15 at 7 years 8 months; showing changes without treatment.

Fig. 18.—Casts of dentition of girl in Figure 15, showing change in incisal relationship after about three weeks' use of orangewood stick. Buccal occlusion of the upper left first molar prevails.

gain results in this way, there should be no particular hurry about starting. I was convinced long ago as I am now that if the goal in orthodontia cannot be achieved in seven and a half and eleven years as shown in Figures 2 and 4, respectively, it would be better not to start at all rather than to leave it unfinished in the end.

From these and many like experiences, it appears that the time for beginning orthodontic treatment is usually determined in an arbitrary way. There is no sound foundation, no reasonable justification for the time of starting treatment. The prevailing kind of malocclusion, the age of the patient and the ability of the operator are insufficient reasons for decisions of this kind. Procedures which consume unlimited stretches of time and expenditure of money, particularly when the outcome is, as it appears, questionable, should be decided upon after more deliberation and with some hesitancy. It

Fig. 19.—Casts of dentition of girl in Figure 15 at 11 years 2½ months, with normal occlusion.

Fig. 20.—Casts of deciduous dentition in Class II, Division 1 malocclusion, in boy 2 years 9 months old. Treatment was not yet advised.

would seem that economy of both time and expense cannot be overlooked entirely. After all, orthodontic service, no matter how beneficial it is, cannot be stretched with impunity to consume too great a portion of one's life span.

early the treatment of malocclusion is begun, it cannot be satisfactorily completed before a stabilized stage in the development of the dentition has been reached. Such stages are attained after the eruption of the permanent second

Fig. 21.—Casts of dentition of boy in Figure 20; Class II Division 1 malocclusion when orthodontic treatment was begun, at 9 years 2 months.

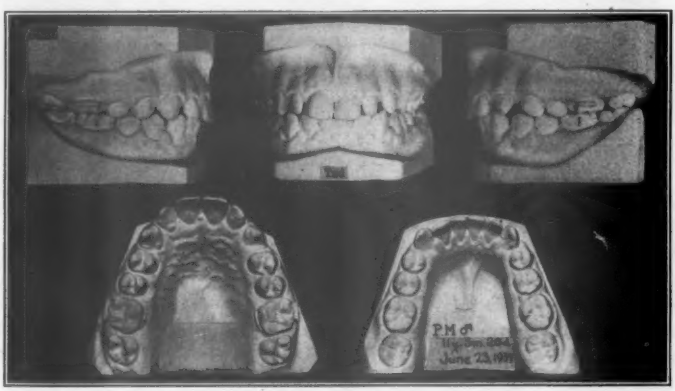

Fig. 22.—Casts of dentition of boy in Figures 20 and 21, after two years of treatment, at 11 years 4 months. The second molars are erupting.

3. *What in my experience points to the solution of the time problem in orthodontic treatment?*

I am convinced that, regardless of how

and third molar teeth. The eruption of the third molar teeth must regrettably be left out of account. The third molar teeth are very much delayed in eruption

and often do not erupt at all; or they may be missing entirely. There is much evidence supporting the view that, regardless of age, one cannot be reasonably sure of a lasting result before all permanent second molars have erupted and before it is definitely certain that they are in normal occlusion. Lilah Clinch, in a recent article,[7] endorses this view in different words. She says: "We have the alternatives of commencing treatment early and carrying retention up to the time of eruption of the second permanent molars, or timing the start so that completion shall coincide roughly with the completion of eruption of the second permanent molars."

Fig. 23.—Casts of dentition of boy in Figure 20-22, one and one-half years after completion of treatment at 12 years 10 months.

To emphasize the truth of this point, the evidence of one of many cases in practice will suffice. This case is shown in Figure 5. The casts present the dentition of a boy at the age of 9 years. It is a Class I case, Angle classification. There is not much wrong with the dentition. The incisors are all crowded and the upper lateral incisors are a bit rotated. The one on the left is also in lingual occlusion. According to development, this case is in the "mixed" dentition stage, with the permanent incisors and first molars erupted, the deciduous canines and both molars still present. I was of the opinion then (1919) that this was a simple case and should not require a very long period for finishing the treatment. It would have been correct if the dentition as it was then had not changed, but had stayed that way. In the course of treatment, however, all the deciduous teeth were shed and their successors came in either out of alinement or rotated, or both. By the time they were all corrected, as is shown in Figure 6, three years and nine months had passed. The patient was then 12 years and 9 months old. I realized at this point that the treatment was not finished.

As shown in Figure 6, the upper canines are not as yet completely erupted, the lower second molars are just about half through the gums and the upper second molars are entirely absent. It took another year and a half for the upper second molars to erupt. They were slow as shown in Figure 7, the right upper second molar has just piereced the gum, and the left is about half erupted. By this time, the lower second molars and upper canines have reached their full eruption. But while the canines im-

proved their position, the second molars did not.

As shown in Figure 7, occlusal and left views of the casts, the upper left second molar was in buccal occlusion. By the time this condition was corrected, the right side was similarly disturbed, and the same corrections had again to be made. Thus, not until all of the second molars were fully erupted and in normal occlusion was I certain that the treatment was successfully completed. Figure 8 shows the completed case. By this time, the patient was 17 years of age. Now, from 9 to 17 is a very long time to give to the treatment of what was originally considered a simple case of malocclusion. Of course, in the light of this and many like experiences, now I do not think the case was simple to begin with. But I insist that eight years of orthodontic treatment is entirely too long.

What can be done about it? My answer is simple: As stated above, there is no case of malocclusion in the orthodontic repertoire which can be treated and completed before the permanent second molars are erupted and in normal occlusion. The second molars have their way of erupting and they take their time about it. The only thing for us to do is to learn and know when they should erupt and in what sequence eruption takes place. We do know that they erupt after all the deciduous teeth have been shed. Sometimes, they are known to erupt even before the deciduous second molars have been shed. According to such a schedule, the earliest a successfully treated case can be safely dismissed is definitely indicated. With the limit set, it is not difficult to appraise the length of time it will take to accomplish the job. All other things being equal, the time can be measured by the changes entailed in the transformation from the dental stage at the beginning to that at the end. Let me put it more directly: According to recent investigations, the permanent second molar teeth erupt, on the average, at 13 years in both boys and girls. Of course, there is a range of variability of about three years. But to take into account just the average, it is easy enough to estimate, approximately at least, how long the treatment of any case will take, when the age at which it is begun is subtracted from the average age of 13 years.

Of course, just knowing how long treatment takes does not help much. The point is—of this I am convinced—that orthodontic treatment under the most favorable circumstances, when started too early, takes too long. I am also convinced that stretching the time of treatment impairs the quality of the results, and, conversely, the chances for favorable results are often enhanced by reducing the time it takes to attain them. Since the end of treatment is limited by the peculiarities of development, and since the beginning depends on our own choice, much can be gained by subordinating the expedient to the inevitable. We must confine our preferences to the needs of the occasion.

How is it done? There is no magic formula on how to proceed. The way I go about it is simple to explain: When I am certain that a patient has malocclusion, I am also convinced, and make it clear that treatment is indicated. I prefer, however, not to start treatment before the dentition is at that stage of development most favorable for a successful result, regardless of the age of the patient. One of the phases in the stage of dental development that I particularly favor is shown in Figure 9.

The dentition, as presented in the casts of this patient, consists of all permanent teeth except the lower right second premolar and all second and third molars. The patient, a girl, was 11 years 8½ months old, the dental development being at the stage that I consider the most propitious time to start treatment. Recent research reveals that when the dentition reaches this dental formula, the face and jaws are at their maximum growth.[8]

Things favorable to orthodontic purposes just appear to happen and there seems to be little trouble involved. Treatment, therefore, is at this stage not only rapid, but also gratifying. Thus, as shown by the casts in Figure 10, the result obtained by active treatment is very satisfactory. The time it took to get it was just nine months. The eruption of the second molars is now being completed and is being carefully watched while retention is still on.

Figure 11 shows the case of a girl aged 12. As indicated by the dental formula, she is a little behind the other girl in stage of dental development. The upper left canine is not quite fully erupted and the upper deciduous second molars are still in place. Active treatment was started in January 1937 and completed in April 1938. (Fig. 12.) Thus, because of tardiness in development, the treatment required six months longer; i.e., a year and three months altogether. Although the patient is 13 years, 3½ months of age now, only one of the second molars (the upper left) is erupting. In this case too, retention will be maintained until the teeth are all in place and in normal occlusion.

In Figure 13 are shown the casts of a third patient, a boy, 11 years 9 months old. Although he is the same age as the girl whose dentition is shown in Figure 9, and younger than the girl in Figure 11, the dental formula is much further advanced than in either of the girls. The deciduous teeth have all been shed and the permanent second molars are erupting. Moreover, the dentition is in much more marked malocclusion (Class II, Division 1) than the others. Had there been any choice, it would have been preferable to start treatment about a year before the eruption of the second molars had begun. Under the circumstances, the optimum time had passed. It was in June that these casts were prepared. Because of the summer vacation, treatment was started early in September. The following May, eight months later, the stage of retention was reached. The casts shown in Figure 14, therefore, represent the dentition of this boy after eight months of treatment. It might be pointed out that, in this instance, by the time active treatment was completed, the second molars had fully erupted and, as shown in the illustration, all of them were in normal occlusion.

It should be realized that these cases, as it happened, were brought to me at just the optimum time. Treatment was consequently started at once. Of course, all orthodontists do that. Is that an assurance of success in treatment? In successful orthodontic achievement, it is an assurance of reducing the time of treatment. Qualifications beyond just stumbling upon the proper time are necessary to success. But they need not bother us now. A more important question is: What is to happen to patients coming to orthodontists before or after the optimum time? After all, children or their parents have no way of telling orthodontic time. They come when aware of the trouble or when directed by professional confrères or grateful patients. It is my opinion that there is no problem at all when they come later than the optimum time. It is any orthodontist's guess as to what is possible and what he can do with prevailing conditions which are not likely to improve in time. What I consider a real problem, a problem in which I am keenly interested, is the procedure to follow when chidren are brought to me much earlier and, as it happens, by overanxious and/or much scared parents. How I proceed will become clear by the presentation of just two cases.

The casts of the dentition of the first case are shown in Figure 15. In my estimation, one of the most difficult situations faced by orthodontists occurs when a case of malocclusion presents the condition shown in this illustration. The dentition is still deciduous, but it is in

Class III malocclusion and, as an added feature, the upper left deciduous second molar is in buccal occlusion. The child, a girl, was 5 years 11 months of age. The parents had already learned much about the detrimental effects upon the teeth and jaws, and the horrible deformities of the face that would ensue if the child was neglected; and so they were ready to start at once, to avoid any such disaster.

As I understood the situation, there was greater need to placate the parents or at least relieve their anxiety than to start the treatment of the child. Besides, there were some particulars to be taken into account in this instance before tumbling headlong into treatment. The lower deciduous incisors were in the last stage of being shed, with the right central incisor already gone, while the upper incisors were just beginning to be shed. The lower first permanent molars were just erupting. I informed the parents that the condition was as bad as it ever could be. I also explained that nothing could be done just then that would be of much help later on. But they were also assured that, when the obstacles entailed in the shedding of the deciduous incisors were passed, something would be done at once.

Three and a half months later, the dentition of the child had progressed to that shown in Figure 16. Both lower deciduous central incisors were now lost and the permanent central incisors were erupting. By this time, the lower lateral incisors were very loose and all the upper incisors were gradually getting that way. By the time that all the deciduous incisors were shed and the permanent ones were erupting, one year and five months had passed. The casts shown in Figure 17 represent the dentition at the age of 7 years 8 months. As the change in the incisors occurred, the dentition as shown in Figure 17 had been increased by the addition of all the permanent first molars, which, as noted, were not yet fully erupted. The interesting feature at this time was that the malocclusal condition in the incisor region was not as bad as it had been. (Figs. 15 and 16.) But because of other queer things likely to happen to teeth, some real complications arose. The upper right permanent first molar, in the course of eruption, came to a premature and awkward stop. As revealed by the x-ray, the mesial marginal ridge of the permanent first molar was caught by the distal gingival margin of the second deciduous molar crown. The right side view in this illustration clearly shows that. The left permanent first molar, though erupting freely, was in buccal occlusion.

A situation of this sort requires immediate attention, if further trouble is to be averted. The first thing I did was to correct the incisor occlusion. This was accomplished in three weeks. No appliances had to be used for that purpose, just an orangewood stick, flattened at the ends and used as a lever to force the upper incisors forward, the incisal edges of the lower incisors serving as a fulcrum, with a finger of either hand furnishing the power. About three weeks later, the dentition looked as shown in Figure 18. The molar occlusion was left alone, because the teeth were not sufficiently erupted just then. In the meantime, the upper right deciduous second molar was removed to permit the first permanent molar behind it to erupt. No space maintainer was used. Subsequently when it was possible to do so, bands were adjusted on the upper and lower left first molars, and by the use of an elastic from a buccal spur on the upper molar to a lingual spur on the lower, the normal occlusion relationship was established. It took just six months to do that. Nothing more had to be done. The dentition as it looked three years and a half later is shown in Figure 19. Thus, in the course of the change from the deciduous to the permanent dentition, approximately five and a half years have elapsed. But in this

change, a severe case of Class III malocclusion was rendered normal in the course of two intervals of treatment, one of three weeks and the other of six months. The moral of this story is obvious: Don't rush into orthodontic treatment at times when people are most anxious or terrified by fear of what may happen. To do the most good, do what is necessary and when it is indicated.

The last case that I shall refer to is of interest from an altogether different angle. The object was to defer doing anything until the optimum time had been reached. The picture of the casts, of the dentition of a boy 2 years 9 months old, is shown in Figure 20. Careful examination of the casts will reveal the fact that, although this was a Class II, Division 1, case, it was one of the most marked that has come to my attention in the deciduous dentition at such a tender age. But the condition of this dentition, extreme not only in the occlusion, but also in the wide spaces between the individual teeth, as shown by the occlusal view, was most unusual and very disturbing. The parents had been advised by the dentist, the pediatrician, the rhinologist and the family physician to have the condition corrected at once. I agreed with the parents and all the doctors that the malocclusion was bad, but I emphasized the fact that it was so bad that it could not get any worse. And since the boy was normal in height and weight according to the available standards, they all agreed with me that the malocclusion of the teeth so far had had no ill effect upon his growth and development. Moreover, it was shown that most of the facial dimensions were within the normal range. Since there were no indications of detrimental effects on health and development, I questioned the need for immediate orthodontic treatment. (By the way, the patient was the brightest youngster that I have ever seen at his age or at twice his age.) I suggested keeping the boy tentatively under developmental supervision and watching for what was going to happen. Accordingly, he was brought to me every three months at first and less often later on. The parents were understanding people and so were not difficult to convince. But the professional confrères were not so easy. However, by the use of careful records of developmental progress, I managed to stave off treatment for six years and a half. When the boy was 9 years and 2 months old, his dentition had changed to the stage shown in Figure 21. The boy was growing fast, everybody was getting desperate and I was beginning to weaken. The replacement of the deciduous teeth by the permanent and the addition of the permanent first molars did not change the occlusion, but made it look worse. So while I would have preferred to hold off about another year, I yielded and started treatment at this time. Unfortunately, owing to a sinus infection, which, I think, bothered the physicians more than the patient, interruptions during treatment could not be avoided. In the winter, the boy had to go south; in the summer, out west. It therefore took longer than I liked to finish the treatment. In Figure 22 are shown the casts after completion of the treatment. They were made when the boy was 11 years 4 months old, exactly two years after starting active treatment. The upper molar bands are still on because he continued to wear the arch and elastics every other night. A year and a half later, the dentition looked as shown in Figure 23. The point is that if I had started treatment when the boy was brought to me, as is customary, he would have been under treatment eight and a half years. Under the circumstances, there was an economy of six and a half years. The gain when looked at from this angle is obvious. The result, I am sure, was not jeopardized by the economy in time.

RÉSUMÉ

1. Because of the general lack of reliable and specific knowledge regarding the effect of malocclusion on life and health, opinion about the most propitious time for orthodontic treatment is greatly divided.

2. The testimony based on actual practice fails to support the arguments in favor of early treatment.

3. Early treatment tends to prolong indefinitely the period of orthodontic care and offers no assurance of better results.

4. Unduly long periods of orthodontic treatment influence unfavorably the tissues composing the teeth and those surrounding them.

5. Economy in treatment is essential in the consideration of time and the expenditure of money because (a) the span of human life is too limited to allow a large portion of it to be spent in regulating teeth, and (b) too great a financial burden eliminates a large portion of the population from the benefits of orthodontic services.

6. Evidence from practical results gathered many years after proves that orthodontic treatment, to be of greatest benefit to the patient, must be completed in a short time.

7. The most favorable time to gain desirable orthodontic results is the period of maximum facial growth.

8. Active tissue growth during tooth movement facilitates bone transformation, hastens tissue recuperation from strain and promotes regeneration in injuries.

9. Since the period of maximum facial growth precedes eruption of the second molar teeth by at least a year, it may well be considered as the optimum time for successful and beneficial orthodontic treatment.

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WHERE AND HOW MAY ACRYLICS BE USED IN RESTORATIVE DENTISTRY?

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WHILE the use of synthetic resins in dentistry is not new, their application to the filling of teeth and the construction of crowns and bridges is of comparatively recent date. In this country, the first recorded use of synthetic resins for restorations other than the complete denture is found in the literature[1, 2] of June 1940. Some clinicians claim to have used these materials for this purpose for the past ten years.

Because of the great interest shown in these materials, we endeavored to ascertain whether dentists in countries other than the United States had made similar application of these newer resins.

In reviewing the foreign literature, we find an article published by Weder in January 1940,[3] antedating those articles in our literature and describing a technic very similar to that which appeared subsequently in this country. It also illustrates the technical steps and procedures involved in the construction of crowns and bridges made of synthetic resins. Several other foreign articles appeared about the same time.[4, 5]

Searching further into the history of this newer development, we find an article[6] by F. W. Selbach, dated June 1938, in which construction of crowns made of synthetic resins is described, and the fact that the resins were available in four colors, namely, yellow, white, light gray and dark gray, is mentioned.

Necessity is often the mother of invention. Since, in warring European nations, the use of precious metals was denied to them, dentists found it necessary to use substitute materials; in this case, the synthetic resins.

In comparing the development and dental uses of the acrylic resins in this country with those in Europe, it is found that a greater advance in technic and a more rational approach in the use of these newer resins in operative restorations and crown and bridge prosthesis are evident here.

Study of the synthetic resins is being conducted at several dental institutions of the country, at the Bureau of Standards[7] and in the research laboratories of reliable manufacturers of this material. The uses and applications of the synthetic resins are also being studied clinically, and if the enthusiasm which has been aroused can be tempered by a cautious approach to the clinical problems involved, it is probable that this new material will establish a definite place for itself in dentistry.

The dental synthetic resins fall into one of the following groups: phenolic, urea, polystyrene, cellulose, vinyl and, finally, the methyl methacrylate or acrylic group. The last named and its copolymers appear, at the present time, to be best suited for the smaller restorations.

The methyl methacrylate synthetic resins belong to the thermoplastic group

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as distinguished from those which are thermosetting, such as the phenol-formaldehyde types. In studying the plastics comparator chart,[8] Table 1, it will be observed that certain desirable qualities vary in the different synthetic resin materials. One suitable for dental purposes should have (1) toughness (impact strength); (2) flexural strength; (3) tensile strength; (4) permanence; (5) a low cold-flow; (6) high resistance to water and to solvents; (7) a minimum of dimensional change; (8) high relative hardness; (9) moldability, and, finally, (10) adaptability to a simple technic employing inexpensive equipment. While there is no single type of synthetic resin which possesses all the desirable qualities to the optimum degree, the acrylic resins possess these qualities to a degree to make them the material of choice for dental purposes.

PLASTIC MATERIAL	TOUGHNESS IMPACT STRENGTH	FLEXURAL STRENGTH	TENSILE STRENGTH	COLOR	COLD FLOW	WATER RESISTANCE	ACID RESISTANCE	CAUSTIC RESISTANCE	SOLVENT RESISTANCE	DIMENSIONAL CHANGE on MOLDING	HEAT RESISTANCE	FLAMMABILITY	HEAT INSULATION	SPECIFIC GRAVITY	HARDNESS	LOSS FACTOR	RESISTIVITY	DIELECTRIC STRENGTH	MOLDABILITY MINIMUM INSERTS
PHENOLIC:- GENERAL PURPOSES	10	3	3	7	1	6	3	4	1	4	8	3	2	8	5	10	7	4	1
PHENOLIC:- LOW LOSS	8	3	7	7	1	3	4	4	1	2	3	1	7	12	3	4	3	3	1
PHENOLIC:- HEAT RESISTANT	10	4	8	7	1	3	4	4	1	1	1	1	7	13	2		8	8	1
PHENOLIC:-ACID (ALKALI RESISTANT	11	6	8	7	1	4	2	3	1	5	3	2	2	5	4			7	2
PHENOLIC:- SHOCK RESISTANT	2	1	5	7	1	7	4	5	1	6	3	4	3	10	5		9	8	1
PHENOLIC:- TRANSPARENT	7	1	3	7	1	4	2	3	1	5	3	2	2	6	4	7	5	6	2
UREA	9	1	1	1	2	9	4	4	1	7	7	5	5	11	1	9	4	1	3
POLYSTYRENE	7	4	7	5	4	1	1	1	3	3	6	6	1	1	6	1	1	2	5
CELLULOSE ACETATE	4	6	9	4	8	11	4	6	3	9	5	6	4	7	9	8	6	5	4
ACETO BUTYRATE	1	5	10	4	6	8	4	4	3	8	4	6	6	4	8	3			4
ETHYL CELLULOSE	3	2	6	3	7	10	4	2	3	8	5	6	4	2	8	2	2	1	4
METHYL METHACRYLATE	6	1	4	2	5	5	2	2	3	8	9	6	2	3	7	5		2	5
VYNIL (NO FILLER)	5	1	2	6	3	2	1	2	2	3	8	6	2	9	7	6	3	1	4

Table 1.—The relative order in which the physical properties are found in the various synthetic resins. (G. Brown)

The acrylic resins for inlays, crowns and bridges are generally available in the powder and liquid form. The powder, or polymer, is the polymerized form of the liquid monomer. In use, the powder and the liquid are mixed in the approximate proportions of 3 to 1 by volume, or 65 to 35 parts by weight, polymer to monomer. This mixture, when permitted to stand in a closed jar, gradually changes to a doughy consistency. The change or the process by which the liquid monomer is converted into the solid polymer is known as polymerization, which is hastened by the application of heat, ultraviolet light or oxidizing agents. The method which employs heat is generally used by dentists in the processing or polymerization of the resin. In a mixture of monomer and polymer, it is important that too much of the liquid monomer be not used, but only enough that all the polymer particles are wetted. The greater the amount of monomer used, the greater the total shrinkage of the object molded; in fact, if monomer alone were used, the total shrinkage of an object would be approxi-

mately 21 per cent. Moreover, since the monomer is a clear liquid, it polymerizes into a clear, transparent polymer; hence, excessive use of the monomer may modify the color of the processed resin.

The physical properties of acrylic resins of special interest to the dentist, relate to (1) dimensional changes; (2) water imbibition or adsorption; (3) color permanence; (4) flexural strength; (5) relative hardness, and (6) cold-flow.

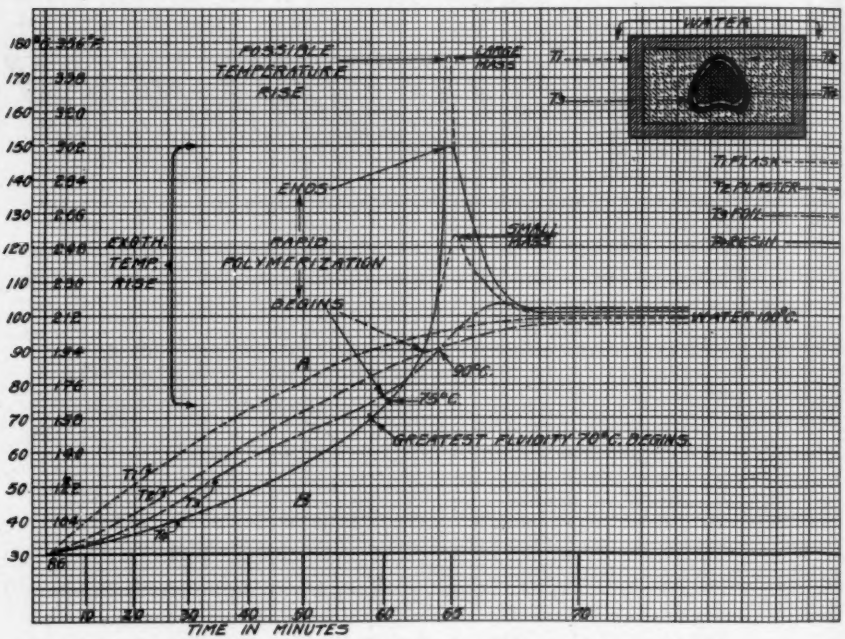

Fig. 1.—Chart prepared by the author in collaboration with W. Barteau, based on experiments conducted at the University of Illinois College of Dentistry, showing the relative temperatures of the resin, investment, tin foil and heating medium.

Three methods can be used to mix the monomer and the polymer, and place the mixture in the mold. With the first method, the one most generally used for both small restorations and for making complete dentures, the liquid and the powder in proper amounts are placed in a jar and thoroughly mixed for several minutes with a glass rod. The cover is then screwed tightly on the jar, where the mixture is permitted to remain for a given length of time, whereupon it reaches a soft, doughlike consistency. In this state, it is suitable for packing in the mold. If a sufficient amount of the monomer has been used, the surface of every particle of the polymer has been penetrated by the monomer. The depth of penetration or dispersion of the monomer depends on both the amount of liquid used and the time allowed for its penetration. When packed in a mold and subjected to heat and pressure, the monomer polymerizes and the entire mixture becomes one solid mass. If an insufficient amount of monomer is used, and if insufficient pressure and heat are applied, it is probable that some of the polymer particles will not be molecularly welded into one solid piece. Hence, care must be exercised that (1) the proper proportions of powder and liquid be

used; (2) a sufficient length of time be allowed for the polymer particles to be thoroughly wetted, and (3) the mass be mixed thoroughly, so that a uniform distribution of the coloring ingredients shall be obtained and all the gross and microscopic air spaces be eliminated within the mass.

A second method of mixing the monomer and polymer has been suggested for the construction of inlays, crowns and bridges. With this method, a small amount of the powder is first placed on a glass slab. To this, monomer is added drop by drop from an eyedropper in an amount sufficient to saturate the polymer. The saturated mass, which has a granular appearance, is immediately taken up with the tip of a spatula and placed in the mold. While in this wet granular state, the mass is vibrated and settled in place. More is added until the inlay or the crown is built to proper form. When two or more colors are employed, a separate pile is made of each powder, saturated with monomer, and each applied where indicated.

If there is an excess of the liquid, it may be absorbed by adding dry powder to the small pile. While this method appears to have certain advantages, it cannot be used with all of the acrylics on the market today. It is primarily intended for those acrylic powders the grain size of which is 100 mesh or finer. This method is not suitable for those powders which are coarser because the finished prosthesis would have a definitely granular appearance.

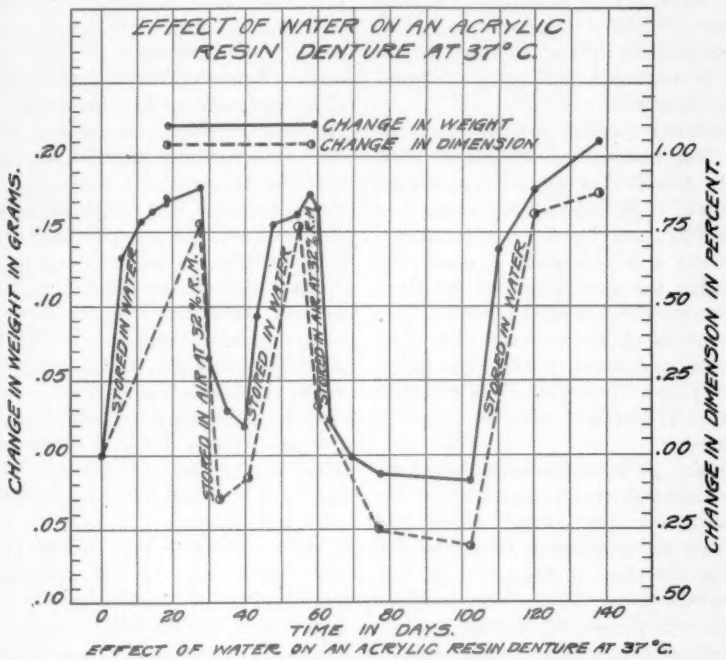

Fig. 2.—Chart prepared by W. T. Sweeney, showing the changes in weight and dimension of acrylics when placed in water.

The third method of mixing monomer and polymer may be called the dry-pack technic. The polymer is sprinkled dry into the inlay or crown mold. First, the gingival color is applied, then the incisal,

also in dry form. When a sufficient amount has been used to develop the contour of the restoration, monomer is added drop by drop from an eyedropper, until the entire mass is saturated. The metal flask containing the mold is now vibrated or tapped on the work bench, so that the moistened particles of polymer gravitate to the deepest portions of the mold. Sufficient monomer is added to slightly oversaturate the mass. The excess liquid is then absorbed by sprinkling on additional dry polymer. This process of alternately adding powder and liquid is continued until the proper contour is developed.

Whichever method is used, after the mold has been filled or, better still, slightly overfilled, a piece of moistened cellophane is placed over the lower half of the flask, covering the exposed acrylic resin, and a trial closure is made. On separating the two halves of the flask, more material is added if needed. Then another trial closure is made; but at no time during the trial are the two halves of the flask brought into complete closure. Thereafter, the case may be processed.

Certain phenomena have been observed during the processing of the acrylic resins, particularly during the time that polymerization takes place. A study of the chart in Figure 1 will help to explain these. This chart indicates the use of boiling water for the processing instead of glycerine or the vulcanizer. It is apparent that there exists a definite time-temperature relationship. Since this material reacts definitely to higher temperatures, it is advisable to start the processing of the crown, inlay or bridge at a relatively low temperature. The temperature reading on this chart begins at 30° C. or 86° F.

After the water has been heated to this temperature, the two halves of the flask are placed in a press and closed to within 1 mm. of complete closure. The flask held within the press is submerged in the water and heat gradually applied so that there is an approximate temperature rise of 1 degree C., 1.8 degree F., per minute. In ten minutes, the temperature of the water will be 40° C., or 104° F.; in twenty minutes, 50° C., or 122° F.; etc. This is continued until the boiling point of water is reached, 100° C., 212° F. It will be observed that the broken line T-1 which represents the temperature rise of the water and flask, continues in a gradually curved line, rising in proportion to the increase in temperature and lapse of time. Immediately below is the line designated as T-2, representing the investment material enclosed within the metal flask. This line also has a relatively proportional rise, but there is an initial lag, because the investment is a relatively poor conductor of heat as compared to the metal flask and the investment is not in direct contact with the surrounding water. The bottom, solid line T-4, represents the resin enclosed within the tin-foiled, plaster-filled flask. It is observed that while the temperature of the resin mass rises in a relatively proportional degree, during the first forty or fifty minutes, there is a considerable lag in its relation to line T-1, which indicates the temperature of the water.

After approximately sixty minutes, the temperature of the resin rises to 70° C. (158° F.). This is the starting point of its greatest fluidity range, which extends approximately to 90° C. (194° F.). During the next few minutes, an interesting phenomenon develops in the resin. Between 70° and 75° C. (158-168° F.), the resin temperature curve T-4 takes a sharp upturn, indicating an increase in temperature which is not externally transmitted heat. During the next few minutes, the temperature rise is very rapid, reaching its maximum at approximately 150° C. (302° F.). From this point, it drops rapidly, and shortly the resin reaches the water temperature level of 100° C. (212° F.). This exo-

thermic temperature rise takes place during the time when the greatest amount and the most rapid polymerization occurs. According to Willard Barteau, chief physicist of Rohm and Haas Co., with whose assistance this chart was made, approximately 95 per cent of the polymerization occurs during this short interval. As the volume of the polymerized mass is increased, the peak of the exothermic curve may rise to 175° C. (379° F.), or more.

The line T-3 indicates the temperature of the tin foil. It will be observed that where the acrylic line T-4 bends upward, it crosses over T-3 at about 80° C. (176° F.). This causes the higher temperature of the acrylic resin to raise the temperature of the tinfoil above 100° C. (212° F.), but only for a short time, for it quickly returns to the boiling point of water at the same time that the polymerized acrylic does. The temperatures of the flask, investment, foil and acrylic resin at any given point may be determined on the chart by dropping a vertical line. Such a line A-B at the 50 minute point indicates that when the flask is 80° C. (176° F.), the investment is 72° C. (161° F.), the tin foil 66° C. (150° F.) and the acrylic 56° C. (132° F.).

The data shown in the chart prompt the question: When does polymerization begin and when is it completed? It is known that only a slight degree of polymerization occurs before 75° C. (167° F.) is reached. At 75° C. (167° F.), polymerization develops rapidly, and, in approximately ten minutes, 95 per cent is completed. The total time from room temperature, 30° C. (86° F.), to this stage of polymerization is approximately seventy minutes. For safety's sake, it is recommended that an additional thirty to sixty minutes be allowed in boiling water in order to complete the polymerization.

The questions may be raised: Is complete closure of the two halves of the flask advisable before applying heat? If not, what is the temperature best suited for complete closure of the flask? It is known that a thermal expansion of the acrylic resin occurs in the range extending from the initial temperature of 30° C. (86° F.) to 70° C. (158° F.); also that an excess of material is recommended during this time-temperature interval. The complete closure of the flask should be made when the acrylic material is between 70 and 90° C. (158 and 194° F.), when the acrylic mass assumes its greatest state of fluidity. It is preferable to make the closure near 70° C. (158° F.) rather than the 90° C. (194° F.) temperature. Even by this method, it is impossible to eliminate entirely the shrinkage which occurs during the processing of acrylic resins. This linear shrinkage may vary from 0.47 to 0.56 per cent, or an average of 0.53 per cent, as shown by Sweeney, Paffenbarger *et al.* at the Bureau of Standards. The use of injector type flasks to force additional material into the hot mold while the enclosed polymerized resin is still plastic, in an effort to eliminate this shrinkage, will introduce internal strain within the crown, bridge or complete denture. This is later released at mouth temperature, a variation in the fit of the prosthesis resulting.

Not only does shrinkage occur, but also, it must be recognized, this shrinkage is not always uniform throughout the molded object, owing to variations in its size, shape and cross-sections. In an effort to keep this shrinkage at a minimum in the construction of complete veneer acrylic crowns, the electrodeposited copper die is employed. But even this improved technic does not entirely remove the strain which is inherent in a crown, and which manifests itself when the copper matrix is removed. The results obtained with the electrodeposited die method are so far superior, however, to those obtained with the use of cement or stone dies that the copper die technic

is recommended in the construction of all crowns, inlays and bridges.

During polymerization, a skeletal framework of molecules or "elastic memory" is created, which is determined by the shape of the mold in which the prosthesis is processed. This skeletal molecular structure is permanent and characteristic of each particular restoration. It is true that such a finished prosthesis can be placed in liquid and heated sufficiently high to be softened again to the point where it may be deformed and then chilled, and thus be given a new form. In the latter form, however, it will be under constant strain, because the inherent molecular framework has been distorted, and it will be constantly striving to resume its original shape. This may explain why so many dentures and complete crowns constructed by the so-called injector method subsequently change shape when exposed even to relatively low temperatures. This problem of inherent shrinkage is one that must be compensated for or overcome in other ways, just as the shrinkage of cast gold was compensated for by the development of thermal expanding investments.

When an acrylic appliance has been processed, there is still further opportunity for dimensional change after it is placed in the mouth. Although some acrylics have a water absorption factor of less than 0.5 per cent by weight, others, on immersion in water, may show an absorption of almost 3 per cent. The amount of water which an acrylic resin absorbs is quite important clinically. The work done at the Bureau of Standards[7, 9] (Fig. 2) shows that acrylic resin dentures which were stabilized at a constant relative humidity of 32 per cent, when placed in water expanded approximately 0.8 per cent within a period of twenty-seven days. It was further noted that acrylic dentures which expanded on immersion in water shrank when they were removed and exposed to the air to dry, and frequently shrank to less than their original dimensions. Slight dimensional changes occurring in complete dentures may be tolerated and compensated for by the mucosa. They do not present the same serious difficulties and dangers which are present in inlays or complete veneer crowns when the prostheses are in direct contact with hard and unyielding tooth tissues. Even a small fractional dimensional change of a cemented crown from a dry to a saturated condition may be sufficient to cause the failure of the restoration at the marginal cement joint. This dimensional reaction of the resins to moisture suggests that crowns made of acrylic resins should be immersed in water until they reach "saturation expansion" before being cemented.

If the available total water expansion is from 0.8 to 1.0 per cent, by deducting the shrinkage of the processed acrylic prosthesis, which is 0.53 per cent, it is possible to obtain a plus dimensional change of from 0.27 to 0.47 per cent.

A technic may, therefore, be possible wherein the shrinkage incident to the processing of the material is balanced by the subsequent expansion due to water absorption or by the use of an investment material having a sufficient thermal expansion at relatively low temperatures.

Clinical evidence indicates that the acrylic resins are not injurious to mouth tissues, also that they are odorless, tasteless and inert as regards oral secretions. This is due to the chemical inertness of the resins. The permanence of color obtainable in the acrylic resins is also one of its most desirable properties.

The behavior of an acrylic resin in the mouth and under applied stress has a decided influence upon its application and upon the design of the prosthesis in which it is used. The suitability of the acrylic resin for use in inlays, crowns and bridges has been questioned on the basis of its hardness, that is, as to whether there is sufficient resistance of the material to penetration, abrasion or cold-flow. The question is also raised whether, on

removal of the laboratory testing load or the load which may be applied during mastication, there is an immediate and complete elastic recovery of the material, or whether the resultant cold-flow remains as a permanent deformation. When a bridge is placed under stress, a certain degree of deformation, either temporary or permanent, occurs owing to the elasticity of the acrylic material. Apparently, there is a cumulative permanent deformation, due to repeated or intermittently applied stress on a crown or bridge. It is suggested, therefore, that a metallic structural reinforcement may be employed in all bridge prostheses. If this is not done, the gingival marginal seal of the acrylic retainers will be broken when stresses are applied to the pontics.

More is yet to be known on this interesting subject, but additional research and study need to be carried out before final conclusions can be safely drawn. One thing is certain: The acrylic resins are not a panacea: they cannot and should not be used in all cases and types of restorations; neither are they intended to eliminate the use of gold or porcelain in dentistry. On the other hand, the possibilities of the acrylic resins should be further explored and studied, so that their proper place and uses in dentistry may be established.

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CONTROL OF COLOR IN DENTAL PLASTICS

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IN developing synthetic resins for dental application, in which stability of color generally will be of considerable importance, it is obvious that plastics and pigments must be chosen which are stable under the conditions of use. Moreover, since most of these materials are intended to duplicate natural members always present for comparison, such as tissue or teeth, it is desirable that the pigmentation provide for satisfactory color-matching under varying conditions of lighting. For example, inlays which match natural teeth under the artificial light in a dentist's office also should show little color difference out-of-doors in sunlight and in partial shadow. And, of course, these requirements in esthetics must be met by physiologically inactive materials which also possess physical properties, such as hardness and toughness, suitable for the proposed applications.

The complete realization of an ideal is perhaps impossible for mortal man. Though approaches can be made to perfection, it is generally necessary to accept some compromise. Particularly is this true in new developments, where fresh problems are frequently encountered. In the present paper, dealing with color in plastics for dentistry, we are not describing "perfection," but rather are recording progress toward that goal. We shall consider the compromises required at our present stage of development.

That all plastics are not equal in color stability is well known. The change from pink to orange of phenol-formaldehyde resin denture materials in the mouth has been observed by all. Also, the considerable variance in stability of the pyroxylin denture bases is familiar. On the other hand, the so-called "acrylic" denture bases have been remarkably satisfactory in their resistance to color change under conditions of use. Surely any fading of completely cured materials of reputable origin in the time intervals under observation has been insignificant for all practical purposes. Even under strong light in direct exposure, they are remarkably stable, and this is a rigorous test for plastics.

Of the materials popularly classified as acrylic resins, those prepared from unmodified methyl methacrylate are among the most resistant to color change. Interpolymerization of methyl methacrylate with other monomeric substances, such as methyl acrylate, vinyl acetate, styrene and butadiene, rarely improves the color stability of the polymer and frequently reduces it. Of course, these modifications may have salutary effects on certain other properties, and hence they are often used in industrial and other applications. But for increasing permanence of color and clarity, such modifiers are not apt to be beneficial. It is also widely known to plastics experts that the best polystyrene resins, sometimes carelessly classed with acrylics, on outdoor exposure become yellow more rapidly than do representative methyl methacrylate polymers.

In methyl methacrylate polymers and interpolymers, modifying agents other than pigments also will influence color stability. As we know, in materials of the powder-liquid type, an inhibitor is al-

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ways employed in the liquid to prevent premature polymerization. Although various substances can be used, hydroquinone is commonly employed. Because inhibitor residues present in the finished polymer may, under certain conditions, go over into strongly colored quinoid forms, it is highly desirable that minimum amounts of inhibitor be employed. For rapidity in thermal polymerization, catalysts, usually organic peroxides, are incorporated in the powder. Some differences in color stability can be observed among resins catalyzed with benzoyl peroxide and with the aliphatic peroxides, such as lauroyl peroxide. The latter are less active under normal conditions of polymerization, however.

Since improper catalyst : inhibitor ratios in acrylic mixes may result in the formation of dense "clouds" of minute bubbles on curing, greatly changing opacity factors, it is evident that proper adjustment of this ratio is important in color control. Further, since the tendency toward bubble formation is more pronounced in large masses of monomer-polymer doughs, it is necessary to cure these with preheating at lower temperatures. The importance of avoiding clouds of tiny bubbles both in the denture bases and in inlay materials cannot be overstressed. The "runaway" bubbles formed by overly rapid curing may be too small for detection individually in pigmented resins, but their presence will greatly alter the opacity of the cured material.

Pigments used in the methacrylate resins must be resistant to color change in the presence of the peroxide catalysts used for curing. Hence, many organic pigments and dyes are of necessity eliminated. But inorganic pigments are usually quite stable under these conditions. The standard pigments employed in coloring rubber dentures can of course be used in methacrylate bases, and the pigments employed in dental porcelain also can be utilized in methacrylate inlays and crowns. In general, harmless pigments, such as carbon black, iron and zinc oxides and titanium dioxide, are preferred, but it is known that less salubrious ingredients can be harmless in the body of the plastic, as witness the common use of English vermilion, a sulfide of mercury, in pigmenting denture bases.

The incorporation of pigments in methacrylate resin during granular polymerization is not easily controlled. Hence, it is customary to pigment the resin after polymerization is completed. This can be accomplished by hot-rolling polymer and pigment. But since such colored plastic masses are not easily comminuted, this type of pigmentation is not commonly used in producing the powder-liquid type of dental material. Here, the coloring matter is dispersed on the surface of polymer granules, which then can be mixed with liquid to form a colored resin.

It is indeed fortunate that Nature has provided a somewhat mottled structure in the tissues we seek to duplicate in denture base materials, the acrylic materials lending themselves admirably to producing a natural appearance, as to both mottled texture and color. However, in restoring tooth substance, a mottled structure is not desired. In making crowns, bridges and inlays, it is important that the particle size of the powder be as nearly uniform as possible from batch to batch, since a difference in particle size distribution will result in modification of color density.

To reduce graininess or granularity to a minimum, the polymer used for tooth restoration should be fairly soluble in the liquid. This need not, however, produce a finished resin which is soft, easily scratched and deformed.

The amount of pigment used is based largely on the particle size. Since the surface of the particle carries the pigment, a given quantity of powder consisting of large particles would have less

surface area than the same quantity of powder containing small particles.

In distributing the pigments on granule surfaces, no methods have been found which are completely fool-proof. Milling methods always result in change of shade of any color formula, as the milling interval is prolonged. This alteration as the pigment is extended is, of course, commonly encountered in the field of pigmentation. It can be reduced by the addition of unctuous modifiers, but careful control in production with checking against previously accepted standards is always necessary.

The powders furnished for mixing should have the pigments sufficiently well worked out that no color change will occur during addition and stirring in of the liquid.

Optical instruments, such as the General Electric (Hardy type) automatic recording spectrophotometer, have been devised which will evaluate colors accurately, permitting precise matching under suitable conditions. Flat specimens identical in surface thickness and opacity are required, which can be prepared readily for comparing one batch of colored resin with another. But since natural teeth and living mouth tissue cannot be converted to completely satisfactory forms for measuring, these instruments are less helpful in matching the synthetic materials to the natural members, particularly since the spectrophotometer will not show identical spectral distribution curves unless identical materials are used. And of course we find it desirable to use simpler combinations than those employed by Nature. Hence, we find it most satisfactory to utilize the human eye for matching such different materials. Actually, the human eye at its best, when properly trained, is quite effective; and, of course, it does provide the practical standard which must be met in clinical use.

Color matching is primarily a matter of color identity; that is, the matching of one color with another, which is the standard. Since the visual sense synthesizes sensations or responses to radiant energy of different wave lengths, two colors differing in spectral character may match under one illuminant and not under another.

In other words, materials differing in character and in basic pigments, though identical in shade to the human eye in one light, may not be perfectly matched in others. This fact makes impossible an exact match under all lighting conditions of any inlay with its embracing tooth. But by careful workmanship a very close approximation can be obtained. Since the basic resin in the inlay materials is exceptional in its clarity, by judiciously blending lightly filled powders with those more heavily loaded, pigmentation can be controlled so as to duplicate the opacity of adjacent tooth structure. With this accomplished, and the shade carefully chosen by reflected light in the dentist's office, reasonably good matching in all reasonable environments can be expected. We feel that this matter of matching by reflected light, that is by light over the dentist's shoulder as he faces the patient, is important in securing a good match. In using shade-guide specimens, illumination by transmitted light should be avoided when the guide is in the oral cavity.

An article by Paffenbarger, Schoonover and Souder in the January 1938 issue of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION contains a table (No. 12) in which is tabulated the opacity of human teeth.

Opacity of human teeth should be studied and considered by the manufacturer in the development of plastics for inlays, crowns and bridges.

The dentist should also consider the opacity of the tooth, or adjoining teeth, while determining the shade for the plastic.

Tooth enamels (specimens 1 mm. in thickness) have an opacity range of 21

to 67 per cent reflectivity, 100 per cent representing complete opacity. Dentin has an opacity range of from 50 to 87 per cent. American Dental Association Specification No. 9 for silicate cements gives a range for certification of not less than 35 or more than 55 per cent. Since this has proved to be a practical range for tooth restorations, the base powder to be used for inlays, jacket crowns and bridges should be in this range. Naturally, if the base powder is too opaque or too translucent, in other words too far away from the normal tooth in opacity, subsequent shading and blending to make esthetic restorations would be extremely difficult for the operator.

Another factor to be considered in building an inlay, jacket crown or bridge is the gradual blending of one color with another and the fading out of one color from a deeper shade to a lighter shade or vice versa. This is influenced by the difference in thickness of the prosthesis and the shade combinations employed.

The subject "Control of Color in Dental Plastics" may also include some practical suggestions for controlling color during the restoration.

When building a jacket crown, many methods have been suggested for blending the body (dentin) and incisal area (enamel).

The most accurate method that I have found, where one curing is desired, is the use of relief molds.

The crown is invested in the regular way; that is, the entire labial surface is exposed and tipped at about a 45° angle. Separating medium is applied and the top half of the flask is then poured. As soon as the plaster has set hard enough to break with a clean fracture, the flask is separated *without* heating. The top half of the flask is marked number one. This is the contour mold.

Next, a portion of wax is removed from the labial surface, the amount removed depending on the degree and position of translucency required. For average cases, about one-half the thickness of the incisal edge is removed and the wax gradually tapered to a feather edge at the gingival border.

Again the wax and plaster investment is lubricated, and another top half of flask poured to make the relief, or number two, mold. In packing, the body (dentin) is placed and the relief mold (second top half of flask) used. It is well to heat the flask for two to three minutes to toughen the material, thus reducing the possibility of distortion or displacement when the more translucent mass is added.

After complete closure with the relief mold is accomplished, and the excess has been removed, the translucent (enamel) mass is placed, the contour mold (first top half of flask) being used. The case is now trial packed, the excess removed, the flask closed and the case cured.

By this method, each pressing is done with a maximum of compression, since the mold is completely filled in both cases. Further, the division line between dentin and enamel is accurately controlled so that no hit or miss method is employed in applying the different colors. The blending is uniform. To obtain equal results, two separate curings would be required.

It must be remembered that plastic resins for tooth restorations are still in the embryonic stage, and we should expect changes in them for some time.

I believe that, with all the work that has been done on resins, future developments will not come so much in the type of pigments used for coloring, but in, first, possibly some new and, as yet, unknown types of resins; second, a proper cementing medium, which is at present dentistry's weakest link, and third, advancement in technic and application.

THE JOURNAL *of the* AMERICAN DENTAL ASSOCIATION

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THE BOSTON MEETING WILL BE HELD!

OF all the rumors which have originated from and have been circulated about the present war activities, the latest and probably the most absurd and baseless one is to the effect that the Annual Meeting of the American Dental Association scheduled to be held in Boston in August of this year is to be postponed because of the war emergency.

The President of the American Dental Association, Oren A. Oliver, is very much perturbed over circulation of the rumor and he has asked us to publicly and emphatically contradict it. Dr. Oliver assures us that no thought of postponement is in the mind of any one concerned in preparation for the meeting.

Needless to say, if it became a matter of patriotic duty to postpone or abandon the Annual Meeting as a war measure, the American Dental Association, through all its representatives and administrators, would wholeheartedly support such an eventuality, but there has been no intimation of such necessity from any official source.

The only reason for not holding the meeting would be government or state prohibition, and careful checking with state and government officials assures us that no such restrictions relative to dental meetings

are in effect now, nor are they contemplated for the immediate future.

This rumor has not the slightest basis in fact and only serves to cause much confusion among the profession.

No! The Boston Meeting has not been postponed, nor is postponement contemplated!

THE PROCUREMENT AND ASSIGNMENT SERVICE FOR PHYSICIANS, DENTISTS AND VETERINARIANS

IN our March issue, we published in full the plan proposed by the Health and Medical Committee of President Roosevelt by which the professional services of the medical, dental and veterinary professions will be made available to the Selective Service System. The plan provides for the utilization of the services of the medical, dental and veterinary corps to the best advantage of the Army and the industrial and civilian centers of population and includes the services of practically every dentist in the United States.

The rapid and continuous development of the Army and Navy medical departments means that additional dentists will have to be made available in considerable numbers for some months to come. This means that not only dentists of the draft ages from 20 to 45 will have to be enrolled, but also practically every dentist who is physically fit to pursue his professional duties will have to be enlisted in the service; and the Procurement and Assignment Service has undertaken the task of procuring and assigning dentists throughout the country to whatever phase of the service any dentist can serve.

The increasing demand for dental service in the Army and Navy will work a hardship on the industrial and civilian communities if judgment is not exercised in the selection of men to leave the various communities. Of course, the Army and Navy have the first call, but the Government owes no less an obligation to the industrial and civilian communities for health service commensurate with the needs thereof.

The Health and Medical Committee of President Roosevelt is cooperating heartily in the efforts of the Dental Preparedness Committee of the American Dental Association to meet the dental needs of the Army. The President of the American Dental Association, Oren A. Oliver, has been appointed by the President of the United States to

membership on the Health and Medical Committee; the chairman of the Dental Preparedness Committee, C. Willard Camalier, has been appointed a member of the Central Board of Procurement and Assignment; the Executive Secretary of the American Dental Association, Gerald D. Timmons, has been appointed a member of and consultant to the Committee on Information and a member of the Subcommittee on Dentistry of the Health and Medical Committee, and many dentists have been appointed on the Corps Area committees.

In order to facilitate the work of Selective Service and to salvage some of the registrants who were rejected in the first draft, the inauguration of a test of the rehabilitation program in Virginia and Maryland this month marks the beginning of a long planned nation-wide campaign, and when the results of these pilot tests are evaluated, a date for national application of the program will be announced.

The registrant formerly rejected for dental defects or minor physical ailments will be ordered to appear before the local board and will be told that he has certain defects, but that, if they are corrected, he will be considered fit for military service or for defense industry work. He will be permitted to choose his own family physician or dentist, and when the defects are corrected, the fee will be paid by the Federal Government. Physicians and dentists will be asked to give priority of treatment to these men.

The plan is designed solely to enable the Selective Service System to rehabilitate and make available for service a large percentage of the men in the first draft that were deferred for minor or borderline defects.

We do not expect any shortage of dentists to meet the conditions, but they can be met only in an organized systematic manner. This procedure the Procurement and Assignment Committee assumes in collaboration with the Selective Service System and it places the duty squarely upon the shoulders of the individual dentist.

The Dental Preparedness Committee has virtually solved the problem of the liability of the dentist to military duty other than professional, and now provision is being made not only for commissioning all dentists who enter the service, but also for granting commissions for limited service to dentists with physical disabilities, who may serve in the zone of the interior.

According to the best information available, about 200 dentists have been inducted into the Army as privates, but with the cooperation of the draft boards and the Selective Service System, the Dental Prepared-

ness Committee of the American Dental Association has succeeded in having 185 of these men commissioned in the Dental Corps.

The Dental Preparedness Committee has had some difficulty in obtaining deferment of dental students in the Army, but in the Navy, through the cooperation of the Selective Service System, qualified dental students are allowed ensign commissions, with the purpose of entering the Navy Dental Corps when their education is completed; and it is hoped that, in the near future, dental students will be given a deferment status equal to that of medical students in the Army.

The alteration of conditions and the necessity for equable selection of dentists for Army service from all communities have more or less invalidated the questionnaire that was first sent out. The Government, through the Procurement and Assignment Service, is now preparing to send out a second questionnaire, which will provide more specific and recent information for the guidance of the committee.

These questionnaires will be accompanied by an enrollment form on which the enrollee will have the opportunity to indicate a preference for various types of service. Once he has enrolled and returned the questionnaire and enrollment form in the franked envelop which will be enclosed, he will receive a certificate indicating his enrollment for war service and will be privileged to wear the official button of the Procurement and Assignment Service signalizing such enrollment.

Most of the Selective Service boards have been cooperating with the Procurement and Assignment Service in granting deferment to dentists pending the organization and functioning of the Procurement and Assignment Service Agency. This consideration can be expected to be continued through enrollment in the Procurement and Assignment Service, but—and this is not in the nature of a threat, just a warning—those who fail to return the enrollment blank cannot expect this cooperation.

The entire program and plan of the Procurement and Assignment Agency (published in full in THE JOURNAL, March 1942) have been completed and are now ready for operation. The Dental Preparedness Committee has exerted every effort to prevent the indiscriminate drafting of dentists as private soldiers, and the contacts that the Committee has been able to establish will, we believe, avoid such drafting in the future.

All dentists over 45 will be asked to enroll with the Procurement and Assignment Service at an early date. Those who are essential in their present capacities will be retained and those who are available for

assignment to military, governmental, industrial or civil agencies may be asked by the Procurement and Assignment Service to serve those agencies.

It must be borne in mind that the Procurement and Assignment Service in no way supersedes the Selective Service Laws. The latter provide that every man between the ages of 20 and 45 is subject to military duty, and it is within the power of the Selective Service System to select those men who are to serve.

So that—and here is the warning—if a dentist fails to enroll with the Procurement and Assignment Service, through the blank that will be furnished, and in the future he is called by his local board and he cannot show that he has enrolled with the Procurement and Assignment Service, there will be no procedure whereby he can avoid induction into the ranks.

Therefore, the return of the enrollment blank and questionnaire is of the utmost importance to you and to the Army Service. As looking to the future, the draft age limits have already been extended to be applied in June when all citizens from 18 to 65 will be registered, and since the Procurement and Assignment Service is charged with the responsibility of maintaining the dental personnel for defense industries and the civilian population as well as for the armed forces, every dentist, regardless of age, physical condition, sex or governmental connection, should cooperate in this effort by returning the enrollment blank and questionnaire immediately after receipt.

It is clearly seen that every dentist has his part in this war, and every one should and must be ready—yes, anxious—to do his part.

If you do not receive an enrollment blank and questionnaire soon, you may procure them by writing to the Procurement and Assignment Service, 601 Pennsylvania Ave., N.W., Washington, D. C., or to the American Dental Association, 212 East Superior St., Chicago, Ill.

BIBLIOGRAPHICAL

The Art and Science of Nutrition

By Estelle E. Hawley, Ph.D., and Grace Carden, B.S. Cloth. 619 pages. 139 illustrations. St. Louis: C. V. Mosby Company, 1941.

This carefully prepared and well-illustrated book is intended primarily for nurses, upon whom often falls the task of feeding the sick.

The book is divided into the following sections: Normal Nutrition; Food Requirements Under Special Conditions; Diet Therapy; The Choice, Preparation and Serving of Foods; References; Appendix.

From the standpoints of format, illustrations, typography and tables, this book is an excellent text. Obviously, the authors are experienced teachers. While the book is intended primarily for nurses, its use should by no means be restricted to the members of that profession. Dentists will be interested in the well-presented information on the vitamin content of various foods, foods frequently causing allergic symptoms, illustrations of effects of various deficiencies, basal metabolism and other subjects.

In respect to diet and teeth, a subject considered in one brief chapter, it may be said that the general recommendations are in accord with available evidence on this important subject. There appears to be a tendency on the part of the authors, and this is not uncommon among nutritionists, to set off one "school of thought" on this problem against another. This procedure is preliminary to deciding which side has the better of the argument. Happily, the final recommendations as to what should be done to prevent and control caries are "middle of the road" suggestions. In this chapter, greater emphasis might well have been placed on postnatal development of the teeth, since, during this period of life, nearly all of the calcification of the permanent dentition takes places. Prenatal care is given consideration, and this is proper, but the net impression gained from this chapter is that prenatal care is of far greater significance. This is hardly consistent with the facts. Exception might also be taken to the statement that "the tooth is a living structure and as such must have adequate nourishment for growth," in that it is not accompanied by the qualifications and explanatory material essential to the development of understanding of this organ. In spite of these shortcomings, the book will be a valuable addition to the dentist's library.

Dental Caries

By the Advisory Committee on Research in Dental Caries of the American Dental Association. Ed. 2. Cloth, 277 pages. Chicago: American Dental Association, 1941. Price $2.

The second edition of "Dental Caries" contains 237 author summaries on research or observations related to dental caries. In general arrangement, the volume is similar to the first edition, with forty-three additional summaries. It represents an authoritative presentation of the work reported on dental caries.

The geographic distribution and institutional connections of the authors indicate the comprehensive character of the book. The multiplicity of suspected etiologic agents in caries as stated in the summaries gives an idea of the complexity of the problem.

The author summaries are followed by a detailed supplementary analysis of the abstracts according to subject which is very helpful. The value of the material contained in "Dental Caries" is enhanced by the lack of any interpretation of the relative significance of the various suspected etiologic factors, permitting an unbiased opinion to be formed by the reader.

It should be mentioned that the length of an author summary is no criterion as to the significance of the reported findings. The reader unacquainted with the field of research might be mistakenly impressed by the length of some of the summaries.

This well-bound book on the latest information regarding dental caries should be in the library of every dental practitioner and research worker in this field. The clear typography on off-white paper makes for easy reading. L. W. Burket.

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President's Message

To the Members of the American Dental Association:

THE tragic consequences of war seem now to be engulfing all the earth. The present world war seems destined to make the conflict of a quarter of a century ago look like a local skirmish.

In America's preparation for war, dentistry must take its proper place. One of the important requisites is the classification of all dentists, including information which is pertinent in a time of national emergency as to how many dentists will be in direct military service and how they will be distributed.

Classification is never easy. The listing and classifying of all the members of a nation-wide profession is difficult indeed. Perhaps before accuracy is possible, there must be not only the original replies to questionnaires, but also checking and double checking. There is information pertaining to dentists which must be secured in any investigation and which they must furnish, and with accuracy, themselves.

An effort will be made to secure the names of dentists who are willing to volunteer for active professional service to meet the government's needs. At the present time, this activity is on a voluntary basis. However, the needs of the government must be met even if ultimately it is necessary to change to an involuntary basis.

The new Procurement and Assignment Service of the Office of Defense Health and Welfare Services, recently organized in Washington, D. C., should prove to be a valuable agency for assuring an equitable distribution of dentists, physicians and veterinarians to meet the needs of both the civilian population and the armed forces. Through the American Dental Association questionnaires previously sent out, the necessary groundwork has now been outlined for this survey.

Army dental service, in time of war, will necessarily function under severe handicaps that are not encountered in civilian practice. Nevertheless, a high standard of service must be maintained, and it is therefore to be expected that proportionately greater num-

bers of trained dental personnel will be needed for the armed services than would ordinarily be required by a numerically equivalent civilian population.

The American people are imbued with the determination to achieve a decisive victory in this war. Consequently, they will insist on adequate care for the health of their soldiers. This can be accomplished only by providing trained personnel in sufficient numbers to meet the heavy demands of our armed forces.

The final steps in the printing and mailing of the enrollment form and questionnaire for dentists, physicians, and veterinarians, described in the special article on the Procurement and Assignment Service published in the March issue of THE JOURNAL, are now being completed. Every dentist who receives the enrollment form and questionnaire should return it immediately in the franked envelope which will be enclosed. He will have an opportunity to indicate a preference for various types of service, provided he can justify his choice. Once he has enrolled, he will receive a certificate indicating his enrollment for war service, and he will be privileged to wear the official button of the Procurement and Assignment Service. This does not mean that he is enlisted in the armed forces, but simply classifies him, as a result of his having expressed his willingness to be of service, as having been given an opportunity to select the type of service that he prefers. Let each dentist show his eagerness to help, and let each one be prompt about it. It must never be said of the dental profession that it gave too little, and too late.

Orren a. Oliver

COMMITTEE ON DENTAL PREPAREDNESS

INFORMATION from the Procurement and Assignment Service indicates that the enrollment blank and questionnaire which are to be distributed by that agency will soon be ready for distribution. The blank and questionnaire, which will be mailed from Washington, should be completed and returned, in the accompanying franked envelope, immediately after its receipt.

The enrollment blank will give each man an opportunity to indicate his willingness to serve and in addition will present an opportunity for indicating the preference of service of the signer of the blank. The questionnaire will be used to augment the information obtained from the preparedness questionnaire, and, at the same time, bring the information up to date and give it a war status.

Most local selective service boards have been cooperating with the Procurement and Assignment Service in granting deferments to dentists pending the organization of the above-named agency. Through the enrollment in the Procurement and Assignment Service, this cooperation can be expected to continue, but a note of warning must be issued to those men who fail to return the enrollment blank and questionnaire. It must be kept in mind that the Procurement and Assignment Service in no way supersedes the Selective Service Laws. These laws state that every man between the ages of 20 and 45 is subject to military duty and it is within the power of the Selective Service System to select those men who are to serve. If a dentist fails to enroll with the Procurement and Assignment Service, through the blank which will be furnished, and, in the future, this dentist should be called by his local board and he cannot show that he has enrolled with the Procurement and Assignment Service, there will be no procedure whereby assistance can be offered to prevent induction. From this warning, it may be seen that the return of the blank and questionnaire is of utmost importance to every dentist.

No one can prophesy the limits to which the war may go. At this time, it is not known just what age limits the calls may reach, and since the Procurement and Assignment Service is charged with the responsibility of maintaining the dental personnel for defense industries and the civilian population as well as for the armed forces, every dentist, regardless of age, physical condition, sex or governmental connection, should cooperate in this effort by returning the enrollment blank and questionnaire immediately after its receipt.

Any dentist who has not received an enrollment blank and questionnaire by April 30, 1942 can obtain the forms by writing to the Procurement and Assignment Service, 601 Pennsylvania Avenue, N.W., Washington, D. C., or the American Dental Association, 212 East Superior St., Chicago, Ill.

IMPORTANT NOTICE CONCERNING DENTAL CORPS COMMISSIONS

ANY dentist who may be classified in Class 1A, under the Selective Service System, may now make application for a commission in the Dental Corps in the Army of the United States.

If, after making the application, the

dentist is found capable of meeting the established physical and professional requirements, the commissions will be issued regardless of quota.

This information was obtained from Major Sam F. Seeley, executive officer of the Procurement and Assignment Service. To make application, a letter should be directed to the Procurement and Assignment Service, 601 Pennsylvania Ave., N. W., Washington, D. C.

At the present time, this applies only to those persons who may be in Class 1A, and since only those persons who registered in the first Selective Service registration will fall in this group, the age is automatically limited to 36.

PROCUREMENT AND ASSIGNMENT SERVICE FOR PHYSICIANS, DENTISTS AND VETERINARIANS

THE final steps in the printing and mailing of the enrollment form and questionnaire for physicians, dentists and veterinarians, described in the special article on the Procurement and Assignment Service which was published in the March issue of THE JOURNAL, are now being completed. In the meantime, the questionnaire originally sent out by the American Dental Association has served to provide the United States Army and Navy medical departments with additional names of physicians, mostly under 36 years of age, who stated that they were available for immediate service. The continuous development of the Army and Navy medical departments means that additional names will have to become available, in considerable numbers, daily for some months to come. After the completion of internships for the current year, there will become immediately available to both the Army and the Navy medical departments a considerable number of those who are now completing their hospital training. Especially important is the statement from the Army Medical Department that commissions for limited service will be granted to physicians with physical disabilities, who may serve in the zone of the interior. Those who receive such limited service commissions will, of course, be accepted with waivers of disabilities.

Every dentist who receives the enrollment form and questionnaire should return it immediately in the franked envelop which will be enclosed. He will have opportunity to indicate a preference for various types of service. Once he has enrolled, he will received a certificate indicating his enrollment for war service and will be privileged to wear the official button of the Procurement and Assignment Service.

In times like these, the demands on rapidly expanding federal agencies are tremendous. The difficulties in securing a sufficient number of competent stenographers and typists and the needed office material and space have complicated greatly the problem of maintaining correspondence in the office of the Procurement and Assignment Service. It is hoped that physicians and dentists will be patient in awaiting replies to letters discussing their individual problems, realizing that the primary task at the present moment is to maintain for the Army and Navy medical departments adequate lists of men on whom they may call immediately. No doubt, as the work of the office becomes stabilized, the response to correspondence will be facilitated.

BUREAU OF PUBLIC RELATIONS

CHILD HEALTH DAY — 1942

A PROCLAMATION BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

WHEREAS the Congress by joint resolution of May 18, 1928 (45 Stat. 617), has authorized and requested the President of the United States to issue annually a proclamation setting apart May 1 as Child Health Day:

Now, Therefore, I, Franklin D. Roosevelt, President of the United States of America, in recognition of the vital importance of the health of children to the strength of the Nation, do hereby designate the first day of May of this year as Child Health Day.

And I call upon the people in each of our communities to contribute to the conservation of child health and the reduction of illness among children by exerting every effort to the end that before May Day, Child Health Day, children over nine months of age be immunized against diphtheria and smallpox, the two diseases for which we have the surest means of prevention.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States of America to be affixed.

DONE at the City of Washington this sixth day of February in the year of our Lord nineteen hundred and forty-two and of the Independence of the United States of America the one hundred and sixty-sixth.

(SEAL)

FRANKLIN D. ROOSEVELT.

By the President:

CORDELL HULL
Secretary of State

PROTECT AMERICAN CHILDREN

THE Child Health Day Proclamation just issued by the President is the opening gun in a campaign to have all children in the United States immunized against smallpox and diphtheria before May 1, which since 1928 has been designated by act of Congress as Child Health Day.

Sponsoring the campaign are the Conference of State and Provincial Health Authorities of North America and the Children's Bureau of the U. S. Department of Labor. The U. S. Office of Education, the U. S. Public Health Service, state and local health departments and the public schools throughout the nation are cooperating. State and local health departments will be the agencies for arranging for immunization of children.

The President's proclamation says in part, "I call upon the people in each of our communities to contribute to the conservation of child health and the reduction of illness among children by exerting every effort to the end that before May Day—Child Health Day, children over nine months of age be immunized against diphtheria and smallpox, the two diseases for which we have the surest means of prevention." Physicians in some areas will also advise immunization of children against whooping cough, tetanus or typhoid.

Neglect of these life-saving preventive measures takes a heavy toll in illness

and death of children, Martha M. Eliot, associate chief of the Children's Bureau, today declared. She pointed to the record of 16,922 cases of diphtheria reported in 1941, the majority of which were in children. Figures for this year indicate that this preventable disease is on the increase. She said:

We often think of smallpox as having been permanently eradicated. The fact is that only by continuing to apply our knowledge of vaccination can we prevent this scourge from returning in the form of virulent epidemics. Last year, there were 1,368 reported cases of smallpox in this country. When we think of the appalling suffering and the enormous death toll this smallpox plague caused among our ancestors, and the joy with which they hailed the simple vaccination which protected them and their children from it, we cannot but wonder that so many parents today neglect to have their children vaccinated.

DENTAL CONSULTANT RECOMMENDED FOR CHILDREN'S BUREAU

AT the meeting of the Maternal and Child Health Advisory Committee and the Crippled Children's Advisory Committee to the Children's Bureau, U. S. Department of Labor, both committees passed the following recommendation:

After consideration of the extent of dental services in maternal and child-health and crippled children's programs, the Committee recommends that a dental consultant be added to the staff of the Children's Bureau to advise concerning dental programs in both the crippled children's and maternal and child-health services.

KANSAS DENTAL HEALTH EDUCATION WEEK

By LEON R. KRAMER,* D.D.S., M.P.H., Topeka, Kan.

JANUARY 18-24, 1942 was proclaimed by the Hon. Payne Ratner, governor of Kansas, as Kansas Dental Health Education Week.

The need for effective lay education relative to the benefits of modern dentistry to public health has been recognized by the dental profession in Kansas for many years.

Most efforts in this direction in the past have fallen far short of expectations; mainly because we were lacking in the facts and figures necessary to state the dental problem with certainty and to present a practical, tried and tested program for its control on a scientific and statistically sound basis.

The Division of Dental Hygiene of the Department of Health in Kansas has, for the past five years, directed its efforts toward collection of the necessary data and experimentation in the interpretation of these facts as practical examples as affecting the health, happiness and security of the citizens of the state.

To test the effectiveness of the latest studies in the presentation of the dental problem, a short article was prepared by the director of the Division of Dental Hygiene entitled "Dental Defects Cutting Defense Man Power." This article was submitted to the editor of the *Kansas Government Journal* to determine its appeal from an official and business point of view. It was immediately accepted and scheduled for publication in the

*Director, Division of Dental Hygiene, Kansas State Board of Health.

December 1941 issue, which was then ready for the press.

The favorable reaction to this type of presentation indicated that we had reached the point where we could successfully stage a state-wide dental health education program. This article, together with other factual material, was then presented at a meeting of the officers and committee chairmen of the Kansas State Dental Association, called for this purpose by LeRoy Hodge, of McPherson, president of the society. At this meeting, it was decided that the director of the Division of Dental Hygiene should devise the mechanics of the program and assemble data for presentation to the governor of the state with the idea of soliciting his aid in the promotion of dental health education.

These facts were then presented to the Hon. Payne Ratner, governor of Kansas, who became greatly interested in the problem and willingly agreed to proclaim a dental health education week, later designated as January 18-24, 1942. The officers of the Kansas State Dental Association, who attended this conference, pledged the wholehearted cooperation of the membership of the society.

It was also decided at this conference that the Division of Dental Hygiene should provide all factual material, posters, radio talks, radio casts, news articles, films and other devices necessary to carry out the program; solicit the cooperation of and supply factual material to health and teaching professions and other state-wide organizations interested in child health and defense activities, and send letters to the secretaries of civic, service and other local groups soliciting invitations for the presentation of the dental program to the membership by their dental members, by local dentists or by local public health personnel.

DISTRIBUTION OF EDUCATIONAL MATERIALS

Approximately 125,000 pieces of literature, posters, publicity and other material were assembled and distributed in more than 4,500 letters and packages to the following groups: 20,000 teachers, 1,100 dentists, 500 health officers and nurses, 300 P.T.A. units, 300 American Legion Posts, 200 American Red Cross Chapters, 500 civic, service and other local groups, sixty committees on nutrition, 700 state, county and city officials and others.

The *Journal of the Kansas State Dental Association,* edited by Fred A. Richmond, featured the governor's proclamation on the front cover and contained an electrifying editorial, a two-page spread devoted to the proclamation of Dental Health Education Week and an article containing the factual material used in the program.

EVALUATION OF PROGRAM

Printed postal cards for checking the activities carried on were sent to key men in each locality. The findings were recorded on 100 of the cards returned to date. Several of the largest cities and many smaller ones in which intensive programs were put on have not yet reported their activities.

These 100 cards indicate that the program was carried out in one or more of its phases in eighty-two of the 105 counties in the state.

The governor's proclamation was printed in eighty-two newspapers.

In the 100 newspapers on which we received a report, there appeared 172 release items and other forms of publicity ranging from 4-inch columns to quarter page advertisements. Four journals of state-wide organizations published the article "Dental Defects Cutting Defense Man Power." Many service clubs, county superintendents and health officers reprinted portions of the factual material in local bulletins. Two issues of the official publication of the Kansas State Board of Health featured the Dental Health Education Week program. Several columnists and editors wrote en-

couraging comments editorially.

Six of the seven radio stations, on which reports have been received, broadcast the newscasts prepared for the week. Seven radio talks were given.

Posters were exhibited in store windows of ninety-two of the 100 cities reporting.

Of the 250 service clubs in the state, 132 returned cards stating that the dental program would be presented to their members by local dentists, eighty-eight during the designated week, the remainder in the weeks following.

Dental films were shown to school children and adult groups in twenty-two localities by local dentists and in twenty major cities by health personnel.

Six entire counties and thirty-four smaller cities were added to the state dental health program.

The Kansas State Teachers' Association, Kansas state superintendent of public instruction, Kansas Parent-Teacher Association, Kansas State Medical Association, Kansas Public Health Nursing Association, Kansas State Board of Health, Kansas State Dental Association, the Governor's Committee on Nutrition, Kansas Department of the American Legion and others cooperated in the program.

We believe that this program has been the most effective endeavor toward lay education ever attempted in the State of Kansas.

THE PRIVATE PRACTITIONER'S ROLE IN PUBLIC DENTAL HEALTH DENTISTRY

By LEO J. SCHOENY, D.D.S., New Orleans, La.

THE vast social and economic upheaval now in progress throughout this country is placing many new responsibilities on the dental profession. Never in the history of this nation have public health activities occupied a more prominent and responsible position in our social and economic life than at this time, and never before has the need for a higher geared and higher powered health service been greater and more widespread.

Public health service as it was thought of at one time was a limited activity concerned with the control of communicable diseases, the safeguarding of water supplies and the disposal of waste materials. Today, in this enlightened and advanced scientific age, public health service is known as that branch of science dealing with the prevention of disease, prolonging of life and promotion of the physical and the mental well-being and efficiency of the general public. The broadening scope of preventive dentistry with its closer association with and relation to systemic disease and disorder makes it one of the essential phases of public health.

The fast-growing demand for expansion of public health facilities and the ever-increasing paternalistic tendencies of government in regard to the supply of medical and dental care for the public are causing considerable concern to many members of the health professions. There is a very definite and well-founded fear among many of our den-

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighty-Third Annual Meeting of the American Dental Association, Houston, Texas, October 29, 1941.

tists engaged in private practice that the principle of public health dentistry may, by undue extension, eventually result in complete socialization of the practice of dentistry. We do not seem to recognize this trend toward government control as part and parcel of a general economic dislocation, but, rather, look upon it as a unique and special development confined to dentistry. We do admit that the medical profession is in the same boat, but we do not seem to realize that problems of a like nature threaten the other professions and economic groups as well.

As busy practitioners, attempting to do our daily job of caring for our patients and at the same time keep abreast of the latest developments in our rapidly advancing field, we have little time left to study and consider what may be going on in the other fields. A more nearly complete understanding of the hazards and difficulties confronting these other groups and a greater appreciation of the public's dental needs as viewed from the community problem standpoint may afford us a sounder and broader outlook on this entire question and perhaps aid us in our particular problem.

Private dental practice is largely the concern of the individual dentist and his patient, and since it is impossible to separate the health of the individual from the health of the community at large, the responsibility of the individual dentist in private practice must necessarily extend in both directions. It is as much his duty to concern himself with the public health dental program as it is to meet the demands of his private practice, and this interest should be no less than that expected of the full-time public health dentist. I believe that the average member of organized dentistry in America engaged in private practice has an interest in the public's dental problems and feels that, in his own way, he is contributing to a solution of these problems and discharging his full duty to the public.

In reviewing the pages of dental history, we learn that although the organization of the first public health dental program dates back only about twenty-five years, many worth while contributions were made, by members of the dental profession engaged in private practice, to public dental health problems and to the public health field in general, during the years preceding the creation of this first public health dental program. In view of this record, we can, I believe, accept as fact that the average dentist in private practice is definitely interested in safeguarding the health of the people. We must admit, however, and with sincere regret, that this interest is not so intense or so active as it should be, particularly when it concerns persons not directly under his care in private practice. This interest, therefore, must be increased to a broader understanding and a new high level in application.

The large percentage of young men rejected under the Selective Service Act because of dental deficiencies has served as nothing ever attempted by any organized group to arouse the attention of the nation and focus it on the question of dental health. The astounding news that about 20 per cent of the young men examined were so badly crippled dentally that they could not fulfil their duty as citizens in this national emergency came as a shock to the people of this country and prompted some criticism of our profession. That the condition was the result of neglect was so apparent even to laymen that they naturally ask why it was not prevented. They say that the dental profession should have seen this condition arising and should have instituted preventive measures before it reached this advanced stage. As a matter of fact, this news was in no way a surprise to the dental profession. Organized dentistry knew that a large percentage of the population was not receiving adequate dental attention and that the results of accumulation and neglect

would exact their toll not only from this group of young men, but from young women as well and, for that matter, from among the young and old of both sexes. We called the attention of the public to the evidence of ever-increasing dental neglect among the young and stressed the importance of early dental attention. We inaugurated dental health educational and dental care programs in many states and communities and employed every conceivable means to develop a stronger interest in dental health among our people and to raise the general level of dental health. That the effort has not been completely successful has been due largely to lack of public support.

Many reasons have been suggested as the underlying cause of the deplorable dental conditions which exist. Economic status unquestionably plays an important rôle in this, however not the major rôle, as some would have us believe, because, from general public knowledge, we know that a fair percentage of the young men rejected were financially able to provide themselves with adequate dental care. There are, we know, other reasons that people stay away from dental offices, such as lack of appreciation of the value of dental care, fear of pain, procrastination, lack of time and ignorance of the results of dental disease. Which of these reasons is the most impelling, it would probably be difficult to determine, and rather than lose time in attempting to fix the blame, we should take steps to overcome them all.

Now that the nation is awakening to the value of dental health, and is apparently in the mood to do what is necessary to secure it, something will unquestionably be done to provide it. Whether the right thing will be done and whether it will be done in the proper manner and serve its full purpose without too great a sacrifice of some one's rights depends in a large measure on organized dentistry. Our duty here is quite apparent. We must meet this challenge and perfect a program, nationwide in scope, which will create in the heart of every man, woman and child in this nation a desire for dental health and provide the means for their obtaining the dental care necessary before the politicians or some well-meaning, but misguided health enthusiast beats us to it.

For those who are financially able and who live where the services of a dentist are available, the only problem is that of education. Many people with the means, however, reside in communities where there is no dentist. There are, no doubt, many such communities throughout our country, well able to provide a comfortable income for a capable and conscientious dentist, and we should do what we can to help solve their problem. But for those who are too poor to pay for dental service, education alone will not do the job; dental care itself must be made available. However, since the records show that many existing facilities, both private and public, although admittedly inadequate, are not at present used to their full capacity, there can be no question in our minds that education, though not the sole problem, is at present the predominant one.

Since education is the only true and sound basis upon which health for the individual as well as health for the community can be achieved, we should see to it that all dental health material used in our programs is scientifically accurate, informative and completely dependable. As we all know, much of the dental health educational material used today is without scientific support and, in the light of new discoveries, many of the statements made in public educational literature are contradictory, meaningless and often actually untrue; for example, "During pregnancy, calcium is withdrawn from the mother's teeth for the baby's benefit, with increased caries in

the mother as a result," and "Decayed teeth will recover their health if the correct foods are eaten."

The American Dental Association, through the Committee on Public Health and Education and its Bureau of Public Relations, is at present engaged in bringing its public educational material up to date. But how far will this go in correcting the situation if the doubtful and unreliable material from other sources continues to be used? To my mind, organized dentistry has the only answer to this question. The Committee on Public Health and Education and the Bureau of Public Relations of the American Dental Association should list all questionable literature and statements and, through the component societies of the Association, acquaint the full membership and the proper health and educational authorities with the facts, bending every effort to have all such unsound and misleading statements deleted from their educational literature and replaced with scientifically founded information. The private practitioner, through his local organizations, in cooperation with the local and state public health dentists, can play an important rôle in helping to bring this about. Such problems should not be left entirely in the hands of dentists devoting their full time to public health work, but should be shared by all. Besides, with the full support of the local dentists who are engaged in private practice to back them up, public health dentists can expect greater cooperation from their fellow health workers and can attain a higher degree of respect for dentistry in general. The dentist in private practice must realize too that this obligation of his is not confined to the educational phase of public health dentistry but involves an active interest and participation in the inauguration and administration of dental care programs. This does not mean that he should be called upon to provide dental care, without remuneration, for those of the community whose economic status does not permit them to provide such services for themselves, unless, perhaps, the case is exceptional. The responsibility for dental health does not rest on the dental profession alone, even though in some instances it may have willingly assumed this responsibility. Neither does it mean that the community owes every citizen free dental care. This responsibility should be shared by the individual, his family, his community, the state and the national government.

The private practitioner does not oppose the action of government in providing free dental care for the beggar on the street, for he knows if the beggar came to him, he would come as a charity patient. He is, therefore, a potential liability and not an asset to the private practitioner. The same can be said with reference to all who are too poor to pay a minimum fair price for their dental needs. We should not complain when liabilities or potential liabilities are taken from our shoulders by public health agencies.

The private practitioner should be opposed to the action of any government or social agency functioning under the guise of public health dentistry and under the pretense of aiding the abovementioned lower economic class, in furnishing free dental care to persons who can afford to pay a minimum fair fee, because such action affects his financial security and welfare. Any dental care program which does not have as one of its primary considerations the safeguarding of the private practitioner's financial rights is not economically sound. The private practitioner is dependent on his practice for his livelihood and is justifiably concerned over threatened elimination of any considerable portion of this practice. While the general public welfare is unquestionably damaged by such misuse of the tax monies, private practitioners, as a class, are especially harmed thereby, and the organized profession

should take determined and united action to protect the private practitioner from such unfair exploitation, proceeding toward this objective in the following manner:

1. Seeing to it that its members are identified with and take an active part in all movements for the creation and development of public health dental programs.

2. Having representation on all public boards and committees that deal with the health of the public, as, for instance, boards of health, health committees of the N.Y.A., hospital boards and welfare boards.

3. Requiring all such boards and committees to formulate and put into force sound policies governing their dental activities.

4. Exercising a determining voice in whether dental care in public health programs should be supplied by the private practitioner or the public health dentist and where it should be provided, in the private office or in a public clinic.

5. Assuring that in service rendered by him, the private practitioner has a voice in saying what remuneration he is to receive.

6. Seeing to it that private practitioners are placed in dominant positions on all boards and committees passing upon the financial ability and resources of those persons who apply for free dental care. If such persons are financially able to pay a minimum fair price for dental service, they should be refused treatment at public expense.

Although all of these steps are important and essential, when all is said and done, the last is the most effective means that organized dentistry can employ in its protection of private practice.

The Social Security Act has inaugurated programs for dental health along with programs in many other fields of health welfare, and state after state has started work in dental health as a government undertaking. The dental phase of the crippled children's program is just one of these numerous activities. We also have in operation, at this time, various special programs initiated by the government to provide dental care to such groups as the N.Y.A., F.S.A., W.P.A., etc. The latest dental care program of national scope to suggest itself is that for the rehabilitation of the registrants rejected for dental defects under the Selective Service Act. A program covering this problem was drafted by a committee composed of representatives of the American Dental Association and of the Selective Service System. After approving it, the Board of Trustees authorized the National Health Program Committee to handle the major phases of this program. We should watch for future developments in this direction and cooperate in whatever manner the committee requests.

In a few instances, dental care programs for such special groups have been initiated without the advice or assistance of the dental profession. Those responsible prefer to have our cooperation, for they clearly need it, but if we withhold our aid without sound reason, we can blame no one but ourselves when they go ahead without it and put into force programs which are injurious to our interests. Many of these programs are as yet in the formative or experimental stage. It is the duty of every dentist engaged in private practice to familiarize himself with the dental needs of the particular group to be served and with all details of programs now in operation and of those under consideration or in process of being organized, so as to be able to make an intelligent appraisal of them. We need not and should not agree with or support programs which we know to be impractical, and not for the mutual interests of the public and of dentists in private practice, regardless of the origin of these programs and the apparent pressing need for them. But, in such instances, we should endeavor to

prove our point and be prepared to offer a substitute program that does measure up to public requirements and to the standards set by us. The American Dental Association, through the proper committees, can render a vast amount of aid in this connection to any group or individual member.

And now let us consider the final and one of the most important phases of public health dentistry, the care and education of the patient in the private dental office.

There is no more appropriate or effective setting for teaching the public dental health than the private dental office. The patient voluntarily seeks the services of some particular dentist because of confidence in his judgment and ability. While under the care of this dentist, the patient is in a receptive frame of mind for any information or advice which will aid him in solving his dental problems and contribute to his future comfort and health. At this as at no other time is the advice most likely to make a lasting impression. If the dentist has been active in organized dentistry and has kept pace with the progress of his profession, it is safe to assume that he will provide the patient with the highest type of service of which he is capable. This must, of course, include instruction based on present-day knowledge of dental disease, methods of treatment and possibilities for prevention. His responsibility in this regard is not limited to the adult members of the families that he serves. It is his duty to extend effective dental education, through the adult, to all children in the family.

We know today that the early education and care of the child patient nets large returns in the prevention of dental disease and disorder. The individual dentist engaged in private general practice who does not recognize this truth and who fails to include young children in his practice is not making his full contribution to pubic dental health and, incidentally, is passing up the one sure means of keeping his practice modern, healthy and remunerative.

There is no way of telling what the future holds for any of us, but we can safeguard against those evils that past experience has revealed, following a course which will keep us informed on the nation's social and economic problems as related to our responsibilities, and be prepared to cope with any changing situation.

I believe that the dental profession in Louisiana has kept pace with this changing situation and is in a position today to deal with the new problems arising therefrom. Twelve years ago, the Louisiana State Dental Society inaugurated a state-wide public dental health educational and corrective program, and, simultaneously with this, created the Committee on Public Health and Education to direct this program and to handle other related public health and economic problems. Incidentally, the personnel of this committee has remained intact throughout these twelve years, with a single change.

This program was carried on by volunteer members of the state society, who not only gave generously of their time, but also, in a majority of instances, contributed the materials as well. This was not intended as a permanent program, but was to serve as an example and lay the foundation for the development of a dental health section and program in the state department of health.

In 1940, our efforts were rewarded when one of our members was placed on the state board of health, the dental section was created and a public dental health program was put in operation. This program is operated under the direction of a full-time director and assistant director and is both educational and clinical. At present, dental care for underprivileged children of preschool age and from the lower primary grades is provided by means of mobile dental

clinics, completely equipped, including x-ray units, and operated by full-time dentists. We believe that, in some sections of our state, the clinical phase of the program can be more effectively administered by employing private practitioners in their own offices on a part-time or fee basis instead of sending out dental trailers with full-time dentists in charge. We are making a thorough study along this line.

The Louisiana State Department of Institutions, as a result of our efforts, has employed a full-time dentist to direct its dental program. Under his direction and with the assistance of the dental staffs, composed of members of the state society, the dental clinics in the various state hospitals and other institutions are rapidly being properly equipped and placed on a high plane of efficiency. The Louisiana State Dental Society is also taking an active part in the dental aspects of the F.S.A., N.Y.A., crippled children, civilian defense and all other such programs.

Yes, the dental profession in Louisiana seems to have a full appreciation of the new responsibilities brought on by changes in our social and economic life, and is, I believe, prepared to face them.

CONCLUSION

1. The private practitioner does not discharge his full obligation to society when he confines his professional activities to the care of private patients, regardless of how thorough and conscientious his service may be.

2. The private practitioner must familiarize himself with the dental and economic problems of the public and must play an active rôle in the development, initiation and administration of all public health dental activities, insisting upon policies and measures that protect the rights of all concerned.

3. The private practitioner, through the organized profession, should keep in close touch with the rapidly changing social and economic movement now underway and strive to check the undue extension of public health dentistry into what might well be termed communistic socialized dentistry.

729 Maison Blanche Building.

COUNCIL ON DENTAL THERAPEUTICS

BLOOD COAGULATION AND HEMOSTATIC AGENTS

THE following report was prepared by a Council referee with the assistance of Frank F. Kanthak. The Council has authorized publication of this report as one in the series on pharmacology and therapeutics.

HAROLD L. HANSEN, *Secretary.*

FOR the decade 1926-1936, Chemical Abstracts (American Chemical Society) alone lists approximately 20,000 references to reports dealing with the blood. Many of the reports in the scientific literature are of academic interest to clinicians at present. On the other hand, there are others which are of more or less direct importance since they deal with the causes and treatment of abnormal bleeding. It is the purpose of this report to present a brief account of this phase of the broad topic, together with other material which may be essential to a more rational consideration of problems confronting the dentist.

The blood is composed of the fluid plasma and cellular, or formed, elements. The cellular elements are composed of the red corpuscles, or erythrocytes, white corpuscles, or leukocytes, and the blood-platelets, or thrombocytes. Together, these cells constitute from 30 to 40 per cent by volume of the blood, the remainder being plasma. In the adult male, normally, there are 5,000,000 red cells, from 5,000 to 10,000 leukocytes and from 175,000 to 300,000 thrombocytes, per cubic millimeter.

The substances present in blood have been outlined as follows[1]:

1. Water.
2. Gases: oxygen, carbon dioxide, nitrogen.
3. Proteins: (a) plasma: fibrinogen, globulin(s), albumin(s); (b) cell proteins, excluding hemoglobin.
4. Pigments: hemoglobin (red blood corpuscles), bilirubin (serum), etc.
5. Nonprotein nitrogenous bodies (exclusive of phosphatides): urea, uric acid, creatine, creatinine, amino acids, ammonium salts and a fraction known as "undetermined N."
6. Glucose, lactates, phenols, etc.
7. Cholesterol and such "lipids" as fats, soaps and the phosphatids (phospholipids); together with the intermediary products of fat metabolism ("acetone bodies").
8. Inorganic salts: (a) cations: hydrogen, sodium, potassium, calcium, magnesium, iron; (b) anions: chlorides, carbonates, phosphates, sulfates.
9. Enzymes and anti-enzymes: glycolase, lipase, esterase, diastase, oxidase, antiprotease, etc. (and the proteolytic and diastatic enzymes of the leukocytes).
10. Hormones and other "autocoids" (Schafer).
11. Immune bodies of various kinds.

If blood is allowed to stand after being removed from the blood vessels, it soon forms a clot in which the cellular elements of the blood are enmeshed. The framework of the clot consists of intermeshing needles of fibrin. The fluid and the cellular elements are held mechanically in the minute spaces in the compact network of fibrils. The jelly-like mass is composed of water and solids in a ratio of about 1:1. Clotting may be prevented by the addition of a soluble oxalate, citrate or fluoride, or by a number of organic agents including certain dyes, such as Chicago blue. Oxalate,

citrate and fluoride act by making calcium ions unavailable for the transformation of prothrombin to thrombin. Apparently, the dyes as well as a number of other organic agents act similarly to heparin, a naturally occurring anticoagulant which exerts its effect partly by preventing the activation of prothrombin and partly by neutralizing the action of thrombin itself. Citrated blood may be used in indirect transfusions.

Evidently, the phenomenon of blood clotting is a nicely balanced mechanism providing defense against the loss of an unusual amount of this precious fluid. Briefly, the mechanism of blood coagulation depends on the transformation of one of the plasma proteins, fibrinogen, to an insoluble fibrous gel, fibrin. This reaction involves two phases. In the first, calcium ions, blood platelets and a plasma constituent termed prothrombin react to form an active coagulant, thrombin. Thrombin then reacts with fibrinogen to form fibrin. There is evidence that both thrombin and fibrinogen are proteins. Demonstrated more graphically, the reaction may be expressed as:

Prothrombin + Ca ions + thromboplastin → thrombin

Thrombin + fibrinogen → fibrin (blood clot)

It should be emphasized that blood coagulation is not a simple process. The theories of blood coagulation have been considered at length by Wöhlisch[2] and summarized by Eagle.[3]

The foregoing schematic representation may depict the general changes which take place, but does not take into account the numerous variables, known and unknown, which may be concerned in the process. Detre[4] has criticized current explanations of blood coagulation on the ground that they are not based upon a certain knowledge of the factors in the unchanged blood. He also pointed out that there exists even now no common understanding as to the nomenclature of substances entering into the reaction in coagulation of the blood.

Among numerous findings relating to the reactions outlined above, the following may be of interest. Blood which has been kept fluid by means of oxalate or citrate may be coagulated by the addition of a slight excess of ionizable salts of calcium, strontium or barium. However, salts of the last two metals are not so effective as are those of calcium. Apparently, it is quite useless to add large quantities of calcium salts; in fact, a large excess may delay clotting. It has been shown definitely that the calcium ions are needed only for the first phase of the reaction. Thrombin itself is active in the absence of calcium ions. The material contained in blood platelets, which has been designated by at least six separate and distinct names, plays a leading rôle in coagulation of the blood. It has been shown, however, that certain aqueous tissue extracts have the same effect as the platelets. The lungs have been found to be particularly rich in this coagulative principle, which has been called cephalin or thromboplastin. This principle has been variously described as a phospholipid and as a lipoprotein. Its exact nature has not been determined. It has been suggested that the active material from blood platelets and various tissues, together with calcium ions, constitutes an enzymic system involved in the transformation of prothrombin to thrombin. There is also reason to believe that thrombin itself is a proteolytic enzyme.

Ferguson[5] has pointed out that Wooldridge was the first to indicate that clotting factors fall into two groups. For convenience, these may be called physical factors and fibrin factors. Among the physical factors are disturbances in gas and ion equilibrium, temperature changes and decrease in surface tension. While it is easy to thus separate factors in coagulation into two groups, it should be remembered that the classification is somewhat arbitrary. Among the so-called

physical factors in coagulation of the blood are those which undoubtedly constitute the basis for commonly employed methods to stop excessive bleeding. Application of gauze packs not only may involve the pressure applied to the bleeding part, but also affects surface tension relationships. Laboratory studies show that the application of heat has a rational basis in that the velocity of coagulation is accelerated with temperature. The maximum is reached at 40-45°C., and further increases delay coagulation. Coagulation is retarded at low temperatures. Stoker[6] has suggested that heat and not cold should be used to control hemorrhage. The effect of heat alone on coagulation time suggests the necessity of using adequate controls in the assay of hemostatic products used at an elevated temperature.

The second group of factors may be outlined as follows:

Fibrin factors

A. In plasma

1. Plasma fibrinogen
2. Prothrombin (thrombogen, serozyme)
3. Antithrombin
4. Antiprothrombin (heparin)
5. Plasma lipids
6. Calcium

B. In platelets and damaged cells

7. Tissue lipids (cephalin; cytozyme, thrombokinase; thromboplastic substance)
8. Tissue coagulant (coagulin: tissue fibrinogen)

C. In clotted blood

9. Fibrin
10. Thrombin (thrombase: fibrin ferment)
11. Metathrombin

The foregoing list contains the names of substances which have been considered to be involved in coagulation of the blood. Also listed are some agents which can prevent clotting of circulating blood. The problem as to why the circulating blood fails to clot is the most puzzling aspect of the coagulation phenomenon.

Many tests have been used in the preoperative determination of abnormalities in the blood-clotting mechanism. Of these, bleeding-time and clotting-time tests are most widely used. Solis-Cohen[7] listed about thirty-three methods. Others have been described since then. In the simple bleeding-time test, an attempt is made to determine how long a roughly standard cut will bleed in the individual patient. For this purpose, a small cut is made in the cleansed lobe of the ear and, at half-minute intervals, blotting paper is touched to the spot, until no further bleeding occurs. The total duration of hemorrhage, then, is called the bleeding time, and normally such a cut will bleed for from two to five minutes. In other tests, other organs or regions may be used and the bleeding time may be different. The clotting time of the blood is determined by filling a small capillary tube with free-flowing blood from a cut in the cleansed lobe of the ear. One half inch lengths of the capillary tube are broken off at regular intervals until it is noted that a strand of fibrin bridges the gap as the fragments separate. The normal variation in clotting time is from two to eight minutes. These two tests describe different properties, because, in the bleeding-time test, the tissue juice factor and various physical factors (vasoconstriction) are allowed to act, whereas, in the clotting time test, these factors are removed. In many instances, both bleeding and clotting time are abnormal.

More detailed investigations may be required. These include determination of fragility of platelets through a study of prothrombin time, capillary resistance, differential platelet count, hemoglobin and iron content and determination of red and white cell counts, including fragility and volume of corpuscles, plasma proteins and water content of blood.

In a study of the bleeding tendency in

jaundice, Ferguson, Calder and Reinhold[8] used simultaneously the Ivy bleeding-time test,[9] the serum volume test of Boyce and McFetridge[10] and the Quick prothrombin test.[11] The jaundice in the twenty-seven cases had various sources. The correlation between tests was good enough to indicate that the simple bleeding time tests may be used in place of the prothrombin test when adequate facilities for the latter are lacking.

Hemorrhage may be defined as a bleeding or flow of blood from the vessels into the tissues of an organ or to the outside. It may be further defined by the location of the bleeding. For example, hemorrhage into the subcutaneous tissues is known as ecchymosis. Hemorrhage may be either traumatic, i.e. the direct result of injury whereby the blood vessels are either cut or torn across, or may be spontaneous; i.e., with no visible immediately recognizable cause. Hemorrhage is often a clinical sign of grave disease of one of the blood-forming organs or the vascular system or arising from the nutritional status of the individual. In many cases of spontaneous hemorrhage, the exact cause remains obscure. This situation prevails because, while much work has been done on the clotting of blood, certain factors, direct or indirect, in its mechanism have not been identified, with the result that abnormalities or variations from the normal remain unrecognized. However, other cases present presumably normal preoperative findings regarding the coagulability of the blood and later proceed to hemorrhage to an alarming extent. This again signifies that our understanding of the mechanism of blood clotting is not complete and that further elucidation is necessary before an accurate prognosis can be given.

Mettier[12] has presented a broad classification of the hemorrhagic states, as follows:

I. Deficiency in blood-clotting elements

A. Thrombocytopenic purpura

1. Essential (idiopathic)

a. Splenic

b. Ovarian (David's disease)

c. Deficiency in megakaryocytes

d. Allergic (focal infections, drugs)

2. Symptomatic

a. Bone marrow destruction, aplastic anemia, leukemia, myelophthisic anemia, arsenic intoxication; benzene, radium, x-rays, septicemia

B. Fibrinogen

1. Liver disease (cirrhosis, chloroform poisoning, leukemia)

C. Calcium

II. Abnormality in blood clotting element

A. Obstructive jaundice

1. Qualitative alteration in fibrinogen

B. Hemophilia

1. Qualitative blood-platelet deficiency (other factors have been suggested)

III. Defect in vascular mechanism

A. Allergy

1. Schoenlein-Henoch purpura

2. Focal infections

B. Nutritional

1. Scurvy (vitamin C deficiency)

2. Protein deficiency (?)

C. Infectious disease

1. Subacute bacterial endocarditis

2. Acute infectious diseases

D. Arteriosclerosis

E. Toxic (snake venom, histamine, quinine, potassium iodide, phenolphthalein). (Others have suggested sedormid, oxalate, fluoride, arsenic and carbon monoxide poisoning.)

F. Congenital

1. Hereditary hemorrhagic telangiectasia

A classification of this sort, while necessarily incomplete, serves the useful purpose of directing attention to the multiplicity of causes of abnormal bleeding. A consideration of these shows at once that therapeutic measures may often fail because of misdirection. For

obvious reasons, the classification contained no mention of vitamin K. Discovery of this vitamin and its action has quietly brought about the abandonment of several agents and procedures that had previously been regarded as highly efficient. Moreover, it has been shown by Quick[11] that patients with the bleeding tendency of obstructive jaundice have a blood plasma low in prothrombin.

Any agent that arrests, totally or in part, the flow of blood or assists in its coagulation may be considered a hemostatic. Historically, pressure applied to a part was perhaps the first hemostatic agent. Ligatures of various materials were used in limb amputations centuries before Christ. The actual cautery and certain plant concoctions later found favor as styptics. Hot oils were also used extensively in the past, particularly in military surgery. Much later, special forceps to clamp the bleeding vessels were introduced and refinements were made in the knowledge of absorbable suture material. Recently, additional progress has been made in the refinement of substances to induce or hasten clotting on a physiologic basis. These, however, are not suitable or intended for arterial bleeding, for in this situation the clamp and ligature methods are the only certain ones.

The coagulating current represents a recent means of controlling hemorrhage that is related to the older method of cautery. In radical surgery, the use of an electrosurgery machine with both cutting and coagulating current may reduce hemorrhage. However, improper adjustment of the current may result in as much loss of blood from this method as from the scalpel method.[13]

Hemostatic agents may be divided into three principal groups; namely, physical, chemical and biologic. The physical hemostatics are concerned with purely mechanical means of occluding bleeding channels, and into this category logically falls the use of pressure, ligatures and hemostatic forceps. It is evident that the most effective use of these devices is confined to accessible areas of bleeding. They form an efficient group of agents for the treatment of oral or postextraction hemorrhage. Perhaps the simplest of them is the application of pressure to the involved area by means of a clean gauze sponge, and by using digital pressure or allowing the patient to bite onto the gauze, creating a firm, steady pressure, which should be maintained for about five minutes. This procedure will in many instances control postextraction hemorrhage by permitting a sufficiently stable clot to form in the socket. Bleeding from a vessel in a bony socket is best controlled by crushing the bone about the vessel by direct pressure from a blunt instrument. This serves to arrest the hemorrhage at the source, whereas methods that ultimately arrest hemorrhage by preventing egress of blood from the socket, as by suturing, result in unnecessary swelling due to bleeding into the tissues. Impression compound plugs molded to fit bleeding sockets or other devices to cover the bleeding area have been proposed for this purpose in particularly intractable bleeding. Molded splints of modeling compound or gutta-percha accurately fitted over the teeth and bleeding socket have been advocated. These may be ligated in place by being fastened to the adjoining teeth or may be retained by pressure from a Barton bandage. At times, the mold may be lined with gauze saturated with one of the hemostatic agents to promote the clotting of blood. This method of treatment is only necessary in unusual cases.

The current edition of Accepted Dental Remedies lists the following as hemostatic agents: ammonium aluminum sulfate, potassium aluminum sulfate, tincture of ferric chloride, ferric subsulfate, including Monsel's solution, and tannic acid. These substances precipitate protein and thus act locally by

occluding the small blood vessels. Accepted Dental Remedies also lists epinephrine hydrochloride (adrenaline), cobefrin hydrochloride, neo-synephrin hydrochloride, thromboplastin and fibrinogen local. Action of the last two substances has been ascribed to acceleration of the clotting process.

In this discussion, vasoconstrictor agents acting systemically have not been considered. Nor has there been mention of means to reduce local blood flow or to induce relaxation and rest (morphine and other depressants). Use of the latter is sometimes valuable in checking severe internal hemorrhage and the basic principles may on occasion be of value in dentistry.

A combination of circumstances, including a definite need for hemostatic agents on the one hand and the difficulty of evaluating such agents on the other, has resulted in the commercial promotion of numerous agents among members of the dental and medical professions. All sorts of substances have been advocated to arrest beeding. The list includes metallic astringents, dietary supplements, vasoconstrictors and "tonics." The use of many of these was and still is based upon empiricism, and it has also been shown that the use of some of them is irrational. There seems to be little doubt now, for example, that administration of metallic astringents by mouth in order to arrest bleeding in remote parts of the body is ineffective and irrational.

The reports of the Council on Pharmacy and Chemistry and the reports of the Council on Dental Therapeutics contain some interesting and important discussions of several hemostatic agents.

Styptysate has been the subject of reports by the Council on Pharmacy and Chemistry[14] and the Council on Dental Therapeutics.[15] Neither council could agree that the available evidence on this product served to substantiate the claims made for it. More recently, Tainter and Throndson[16] reported the results of well-controlled observations on human subjects. These investigators found that styptysate, when given by mouth in large doses over an extended period of time, failed completely to decrease the coagulation time of the blood of normal individuals.

Ceanothyn, which was the subject of reports by the Council on Pharmacy and Chemistry,[17] was found by Tainter and Throndson[16] to be ineffective on oral administration. These investigators drew attention to the fact that in several favorable reports on ceanothyn and other hemostatic agents, there was a lack of adequate controls.

Stypticin and styptol,[18] two other products found not acceptable to the Council on Pharmacy and Chemistry, are preparations of the alkaloid cotarnine. On the basis of negative results obtained by Hanzlik,[19] the Council on Pharmacy and Chemistry omitted cotarnine salts from N.N.R.

During recent years, the use of various snake venoms for control of local hemorrhage has received some attention. The Council on Pharmacy and Chemistry, after reviewing the available evidence for snake (moccasin) venom solution, has concluded that the evidence for the usefulness of this substance in such conditions as functional uterine bleeding, idiopathic epistaxis, multiple hereditary telangiectasis and thrombocytopenic purpura is still inadequate for acceptance.[20]

Reznikoff[21] reported briefly on results obtained with moccasin and fer-de-lance venom in medical practice. Results with the former were unsatisfactory, although the fer-de-lance venom was reported to be effective when applied locally; for instance, on bleeding gums in acute leukemia or uremia. Whether similar results might not have been obtained with any one of a variety of tissue extracts is a question of some importance.

Winter[22] found snake venom ineffec-

tive in hemophiliacs. Cambrook[23] reported favorable results in about fifty cases, including a few of hemophilia.

It is not our purpose to attempt an evaluation of the numerous agents that have been proposed for clinical use in treatment of abnormal bleeding. Such a task is beyond the scope of this article. Essentially, it would involve a detailed examination of each one of a variety of substances. Unfortunately also, the evaluation of hemostatic agents is an extremely difficult problem, not only because of our lack of knowledge at specific points, but also because many of the data in the literature were obtained without adequate controls. This has been shown by Aggeler and Lucia,[24] who, in a biologic assay of blood-coagulating substances, found that nine of seventeen commercially available products were practically inactive. The only products found to be significantly active were those suitable for local or oral topical use. These findings prompted the authors to remark:

> The need for potent hemostatics is recognized. The use of impotent agents in the forlorn attempt "to do something" when confronted with the problem of the bleeding patient should be discouraged.

A number of substances obtained from natural sources have been employed as hemostatic agents either experimentally or clinically or both. Among these are extract of egg white, human milk, extracts of various organs including lungs and brains, pectin and saliva, as well as various products derived from blood. Blood serum itself is regarded as the most effective agent in bringing the coagulation time of hemophilic blood to normal. The efficacy of blood serum has been attributed to its thrombin content. Some of the vitamins either alone or in combination with other substances have been employed for prevention of hemorrhage. Vitamin K was the subject of a previous report by the Council.[25] The available evidence indicates that vitamin C is of value only in cases in which there is avitaminosis. Vitamin D has been used, especially in conjunction with calcium salts. Here also, there seems no logical basis for its use except in those cases in which the blood calcium level is low. Still other naturally occurring substances of interest in this connection are illicin, an active constituent of the Japanese plant illicum anesatum, parathyroid extract, extracts of staphylococci and male and female sex hormones.

It has also been asserted that the injection of pure chemical agents results in a decrease in coagulation time. Among these are sodium citrate, Congo red and calcium chloride. Recently, it has been reported that intravenous administration of sodium citrate and oxalic acid, as well as of commercial blood platelet extracts and hemostatic serum, failed to decrease the coagulation time in anesthetized dogs.[26]

Saliva itself acts as a hemostatic agent. Hanzlik[27] found it to be less active than thromboplastin and cephalin. Bellis and Scott[28] report that human saliva hastens the coagulation of dog, bovine and human blood. Dog saliva collected by cannula gave similar results. Glazko and Greenberg[29] believe that saliva owes its blood coagulation properties to a substance acting as a thromboplastin. They obtained an active impure factor by precipitation with ammonium sulfate, followed by dialysis. The substance appeared to be protein, possibly a lipoprotein, according to these investigators.

During the past few months, several articles dealing with control of hemorrhage have appeared in the dental literature.[30, 31, 32, 33] Of obvious importance are those measures intended to prevent excessive hemorrhage. From the practical standpoint, the following information presented in answer to a question in *The Journal of the American Medical Association* under Queries and Minor Notes[34] is of interest to dentists. The

information deals with tonsillectomy and hemorrhage prevention, but is applicable to dental surgery as well.

Provided the patient is in good physical condition, and the coagulation time falls within normal limits, there is nothing to be given preoperatively to prevent bleeding.

The essential points are a good history, a physical examination and the drawing of inferences and conclusions as to the operative fitness of the patient.

If the patient's history or physical condition is such that doubt is entertained concerning his ability to respond properly to operative intervention, appropriate blood studies should be made. Though such studies are important, complete reliance cannot be placed upon them.

In cases needing preoperative attention, the use of blood or serum is probably more effective than the use of calcium salts, estrogens and placental or other tissue extracts.

The preoperative treatment of patients shown to be in need of such care will depend on the determination of the condition responsible for the abnormal reaction. In many cases, diagnosis and treatment are possible. The condition present may have a variety of causes, however, as was shown under the section on hemorrhage. This at once suggests the advisability of a careful history of the patient and the need for cooperation with a physician in selected cases.

In many cases, prolonged bleeding from sockets is probably not due to deficiencies in the clotting mechanism itself. Prolonged bleeding from a socket may mean that the injured blood vessels are unable to retain the clot because their retractile powers have been lost, through inflammation or arteriosclerotic changes, in a generalized arteriosclerosis. The latter may be complicated by concurrent hypertension.

In those cases in which excessive bleeding takes place in spite of precaution, the procedure to be followed will naturally depend on the character of the particular case. Under ordinary conditions, the use of a clean gauze sponge, together with accepted hemostatic agents, will suffice. In extreme cases, blood transfusion may be necessary.

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ACCEPTED DENTAL REMEDIES

DENTIFRICES*

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following article in the list of Accepted Dental Remedies.

Trade Brand Dental Cream: Composition: See Milkident Dental Cream (A.D.R. Ed. 6, p. 110).

Manufactured by the Trade Laboratories, Inc., Newark, N. J.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information regarding the rules and work of the Council will be sent on request.

HAROLD L. HANSEN, *Secretary.*

*A.D.R. Ed. 7, p. 102.

NATIONAL BOARD OF DENTAL EXAMINERS

CANDIDATES WHO HAVE SUCCESSFULLY COMPLETED PARTS I AND II OF THE NATIONAL BOARD EXAMINATIONS

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COUNCIL ON DENTAL EDUCATION

CONGRESS ON DENTAL EDUCATION AND LICENSURE

THE Second Congress on Dental Education and Licensure conducted by the Council on Dental Education was held at the Palmer House in Chicago, Saturday, February 21, 1942. Minor J. Terry, Albany, N. Y., chairman of the Council, presided. All but four of the thirty-nine dental schools in the United States were represented and thirty-three deans were present. About thirty state examining boards were also represented, by one or more members. One hundred and fifty persons attended the luncheon session, at which Franklyn Bliss Snyder, president of Northwestern University, spoke on the topic "The University and Professional Education."

MORNING SESSION

Greetings were given at the opening of the morning session by Oren A. Oliver, President of the American Dental Association, Benno E. Lischer, president elect of the American Association of Dental Schools, and by Walter F. Barry, president of the National Association of Dental Examiners. The general topic of the morning session was based upon this question: How can obsolete procedures and processes in dental teaching and in dental examining be eliminated and how can teaching and examining become more closely articulated?

The teacher approach to this question was presented by Charles F. Bodecker, professor of dentistry in the School of Dental and Oral Surgery of Columbia University. Dr. Bodecker dealt with the teaching of the sciences, the conduct of examinations and the authenticity of textbooks. Not so long ago, he held, the final examinations of the sophomore class in dentistry closed the door on the sciences. The integration of the sciences with the clinical work is still one of the paramount issues in dental teaching. Comprehensive examinations during the senior year, Dr. Bodecker urged, would clarify the situation between the closely linked fields of science teaching and the clinical application of scientific knowledge.

For centuries, Dr. Bodecker declared, textbooks in dentistry, as well as in other fields, have frequently been guilty of errors, mistaken conceptions and unsound hypotheses. The "single author" textbook has a tendency to perpetuate errors. The plan of having texts written by a number of authors provides checks and balances which are a safeguard against mistaken conceptions and dogmatism. In any form of textbook, care needs to be taken to distinguish between established views and controversial topics in order to avoid confusing the student and giving him a biased view of the subject. The "group-author-consultant" plan may be instrumental in eliminating false and misleading statements from many educational textbooks.

The examiner approach to this question was presented by Philip L. Schwartz, former president of the New Jersey State Board of Dental Examiners. Dr. Schwartz held that the problems of teaching and examining are mutual. He reported in detail upon the results of a questionnaire he had addressed to the deans of the dental schools and reached these conclusions:

1. The basic academic subjects, properly included and emphasized in the dental curriculum, may well be eliminated from qualifying licensure examinations.

2. It is recommended that as a test of the candidate's biologic understand-

ing, boards formulate questions in such a manner as to reveal the candidate's knowledge of theory as applied to practice.

3. In order that candidates may be properly prepared for this biologic emphasis, it is suggested that the colleges give more clinical opportunity for student study of the patient from the biologic aspect, in addition to present emphasis on unit clinical requirements.

4. It is recommended that the requirements in the practical operative examination be more flexible, with tests in varied individual operations, such as Class III gold, a Class II amalgam or preparation of a cavity for inlay reception with a completed wax pattern; the candidate not to be advised in advance of the examination as to which operation will be required. This would tend to assure adequate preparation on the part of the candidate in all three procedures.

5. It is recommended that the practical prosthetic examinations stress the importance of restoration designing and planning in addition to finger manipulation.

AFTERNOON SESSION

The afternoon session was devoted to the general topic: The design of the dental curriculum.

Howard M. Marjerison, dean of the College of Dentistry of the University of Illinois, presented the topic from the standpoint of "integration with medicine," and Willard C. Fleming, dean of the college of Dentistry of the University of California, from the standpoint of "autonomy in administration and teaching."

The major reason, Dr. Marjerison held, why the present design of the curriculum is stifling the integration of medicine and dentistry is that it is attempting to straddle two conflicting objectives. For example, under the traditional philosophy, dentistry attempted to solve its problem by the application of the laws of physics. Emphasis was placed upon digital dexterity. Methods of treatment constituted the unit of study. The student was introduced to dentistry through technical courses during the first two years of his professional study. This same approach was carried over into the two-four plan. The technic courses were set up in the traditional curriculum to meet an entirely different set of objectives from the objectives and philosophy which underlie and justify the two-four program. The patient, rather than the method of treatment, becomes the unit of study. Hence, the set-up of technical teaching in the present program is illogical and out of tune with the new philosophy. It stymies the proper integration of the medical and dental curricula and creates psychologic fixations which are a serious handicap to the development of a biologic point of view.

If dentistry is to be consistent with its biologic philosophy and the aims and objectives of other specialized branches of medicine, it must completely change the direction of its thinking in relation to the problems of clinical dentistry. If the biologic point of view means anything, it means the study of diseases of the oral structures in their relation to the rest of the body. Consequently, dentistry must provide facilities, freedom and opportunities for teachers and undergraduates to study the nature of the structures with which they are dealing, as well as the constitutional make-up of the patient they are treating.

In discussing the afternoon topic from the standpoint of autonomy in administration and teaching, Dr. Fleming proposed a new design of the dental curriculum. Such a new design would provide for a plan of integration, not with medicine, but with the whole science of health service. Dental education would have to be prepared to sacrifice a certain amount of its independence and be prepared to relinquish some of its responsibilities for establishing general

policies and objectives. The transfer of authority would be made, not to the public health group or to medicine, but to the universities. Social, economic and political forces will eventually bring about the change.

Under such a plan, the basic science departments of the university will be reservoirs out of which medicine, dentistry, pharmacy and other health service groups can draw for the preparation of their students. In each case, the college concerned would control the type and amount of the science taught. Medicine will not determine how much dentistry needs, nor will dentistry set the quantitative standards for pharmacy. Summing up the implications of his proposed new design of the curriculum, Dr. Fleming said:

> To do this, we will have to improve the quality of our students by selection and the quality of our teaching by developing dentistry as a university discipline. The teaching of the basic science courses will have to be changed.
>
> We will have to change the idea that the objectives and teaching methods of medicine are patterns for the other health services.
>
> Our technical and clinical courses will have to be shortened and modernized and taught from the standpoint of fundamentals. Most important will be the selection and preparation of our teachers, this selection started in the undergraduate years and our teachers prepared to meet the requirements and standards of the other university schools.
>
> This is the design, or shall we say a rough sketch of a curriculum developed under the direction of dentists and dentistry. There is a great deal to be added before the final blueprints are reached. It will be a difficult task, the success of which calls more upon inspiration than upon integration.

Discussion from the floor followed the presentation of the papers in both the morning and the afternoon sessions. Participating in the discussion were

R. W. McNulty, assistant dean of the Chicago College of Dental Surgery of Loyola University

George W. Wilson, assistant dean of the dental school of Marquette University

Leon M. Childers, secretary of the Kentucky State Board of Dental Examiners

Harry T. Wood, secretary of the Michigan State Board of Dentistry

Carl O. Flagstad, secretary of the American Association of Dental Schools

Robert P. Thomas, secretary of the National Association of Dental Examiners

Walter F. Barry, president of the National Association of Dental Examiners

B. J. LaCour, secretary-treasurer of the Louisiana State Board of Dentistry

Don W. Gullett, secretary of the Royal College of Surgeons, Toronto

Harlan H. Horner, secretary of the Council on Dental Education

Charles W. Freeman, dean of the dental school of Northwestern University.

William F. Lasby, dean of the dental school of the University of Minnesota

Houghton Holliday, associate dean of the school of dental and oral surgery of Columbia University

Harry Bear, dean of the school of dentistry of the Medical College of Virginia

William H. G. Logan, dean of the Chicago College of Dental Surgery of Loyola University

William H. Crawford, dean of the dental school of Indiana University

Sydney L. Tiblier, dean of the school of dentistry of Loyola University, New Orleans

James T. Ivory, president of the Dental Society of the State of New York

Benno E. Lischer, dean of the dental school of Washington University

Frederick C. Elliott, dean of the Texas Dental College

J. Ben Robinson, dean of the Baltimore College of Dental Surgery of the University of Maryland and President Elect of the American Dental Association

Russell W. Bunting, dean of the school

of dentistry of the University of Michigan

Ernest G. Sloman, dean of the school of dentistry of the College of Physicians and Surgeons, San Francisco

Marcus L. Ward, professor of metallurgy and materials of the school of dentistry of the University of Michigan

Telegrams of greetings and good wishes were sent by the congress to William J. Gies, New York City, upon the occasion of his seventieth birthday, and to William N. Hodgkin, chairman of the program committee of the congress, Warrentown, Va., who was unable to attend the congress on account of illness. The Council will publish the entire proceedings of the congress.

RESEARCH COMMISSION

CONSERVATION OF TIN

As tin is one of the metals necessary for war purposes, dentistry, as a profession, can and must help conserve the supply. This can be done by limiting its use as much as possible and recovering all scrap.

The dental needs of the public, the necessity for comparatively low-cost service to meet these needs and the possible reduced availability of dental service to the public because of increased military demand indicate the need for a low-cost permanent filling material which does not require a time-consuming technic. Since amalgam alloy best meets these requirements, it is one of the absolute necessities for adequate public service during the emergency.

We are dependent on the use of tinfoil for the best results in denture work. Attempts are being made by the Research Commission and the National Bureau of Standards to perfect a substitute for tinfoil, but at present the outlook is not hopeful.

It becomes the duty of every dentist, therefore, to save and return all excess amalgam not used in restorations, all fillings which are removed, every scrap of tinfoil cut off in foiling prosthetic cases, every piece of tinfoil removed from cured dentures and all other tin scrap such as toothpaste tubes. Whether the conservation and return of tin scrap will yield an appreciable financial return is not important at this moment.

We shall fare better in the allocation of strategic materials by the Government if we voluntarily and wholeheartedly adopt this and every other means at our hands to cooperate.

EXECUTIVE BOARD,
RESEARCH COMMISSION.
M. D. HUFF, *Chairman.*
D. F. LYNCH, *Secretary.*

NOTES OF INTEREST FROM THE FEBRUARY TRUSTEES' MEETING

CHICAGO, FEBRUARY 20-24

NEW BUILDING FOR THE CENTRAL OFFICE

THE Building Procurement Committee of the American Dental Association reported that the building at 222 East Superior St., Chicago, had been acquired by the Association through purchase of stock held by the corporation owning the building and that it was now the property of the Association. The building is a five-story brick structure, with an ornate stone front, trimmed with wrought iron, and affords 20,000 square feet of floor space. It is well-constructed, but in its present condition is not adapted to the purpose of the Association. Remodeling and rehabilitating to adapt it to the needs of the Association will proceed as rapidly as possible. In the meantime, some of the departments of the Central Office have been transferred from 212 East Superior St. to the new building.

A JOURNAL ON ORAL SURGERY

The Trustees, at the request of the American Society of Oral Surgeons and Exodontists, voted to undertake the publication of a journal of oral surgery, to be devoted exclusively to oral surgery and exodontia. The journal will be under the managerial supervision of the Editor of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, with Carl W. Waldron, Minneapolis, Minn., as editor and head of an editorial board which will direct the publication of the journal, the board consisting of six or eight prominent oral surgeons in addition to Dr. Waldron and acting as his assistants.

The Journal of Oral Surgery is to begin publication as soon as the details can be arranged. Nearly 3,000 dentists have agreed to subscribe to the new journal at the subscription rate of $5. The journal is to be a 96-page quarterly magazine and is to be profusely illustrated and of such appearance as will be highly creditable to the oral surgery group and to the American Dental Association.

A MONTHLY NEWS BULLETIN

The Trustees also, at the recommendation of The Journal Committee, approved a plan to issue each month, under date of the 15th of the month, a news bulletin or Journal supplement to be sent to each member of the Association, containing news of the most recent developments in the war situation, and also any items of interest concerning the activities of the Central Office, and in the profession at large.

AFFILIATED MEETINGS A.D.A.

At a meeting of the Board of Directors of the Chicago Dental Society three months ago, a resolution was adopted with the purpose of discouraging the holding of affiliated group meetings and societies at the same time as the Chicago Midwinter Meeting. The subject was brought to the attention of

the Trustees of the American Dental Association, who adopted a resolution to encourage such meetings.

PRIORITY OF DENTAL SUPPLIES The Trustees were addressed by Col. C. F. Shook, chairman of the Medical Supplies Committee of the Army and Navy Munitions Board, who discussed with the Trustees the question of production of dental supplies and stressed the necessity of active cooperation of the dental profession for conservation and standardization of dental materials as related to the present war emergency. Colonel Shook suggested that a committee from the Association be appointed with the duty of securing adequate production of dental equipment, materials and supplies which are regarded as essential to competent oral health service. He also suggested that the committee might find sufficiently urgent need for a full-time representative at Washington to guarantee the source of supply to the profession and recommended that such a representative be approved by the Board of Trustees.

MAIL ORDER DENTISTRY The Committee on Legislation reported that a bill was being presented before Congress by Congressman Traynor, of Delaware, prohibiting mail order dentistry. It has since been announced that the bill has been passed by Congress and is waiting action by the Senate. In the legislative department of the present issue, a more detailed account of this action is published.

NATIONAL HEALTH PROGRAM COMMITTEE The National Health Program Committee reported a full and explicit plan for rehabilitation, which has been adopted by the Government and is now under trial in two states. If the plan is entirely successful, it will be generally applied at an early date.

A.D.A. JUNIOR MEMBERSHIP CONTEST The Membership Committee reported a plan for increasing Junior Membership in the Association, which the Board of Trustees approved and in which the three vice presidents of the Association, Drs. Scherer, Sloman and Dunning, are cooperating. The plan provides that the country be divided into four sections with as nearly an equal number of schools in each section as possible and that the deans of the schools in each section select an essayist from the junior class to present an essay under the title of "The Value of Dental Organization." The essays from the various contestants will be considered by a committee from the American Dental Association, which will select the best essay from the contestants of each of the four zones. The winner in each zone will be invited to attend the Annual Meeting of the Association as the guest of the Association with all expenses paid. When he returns from the meeting, he is to write an essay on some phase of dentistry, which will be published in THE JOURNAL.

It is hoped by this plan to materially increase the Junior Membership, which is now well over 3,000.

SEVENTY-EIGHTH ANNUAL MIDWINTER MEETING OF THE CHICAGO DENTAL SOCIETY

WITH traditional emphasis on scientific section meetings and limited attendance clinics, the Chicago Dental Society's Seventy-Eighth Annual Midwinter Meeting brought 6,242 dentists to the Palmer House in Chicago, February 23 to 26. The total registration was 12,016.

At the first general session, on the morning of February 23, Glenn E. Cartwright, president, presented awards in the society's first annual nation-wide competition for original scientific investigations "of new significant value to dentistry."

LeRoy E. Kurth, a Chicago practicing dentist, received the first award of $300 for his essay, "Mandibular Movements in Mastication," and Hermann Becks, of San Francisco, received the second award, $200, for his paper, "Dangerous Consequences of Vitamin D Overdosage on Dental and Paradental Structures." The essays of Dr. Kurth and Dr. Becks were read at the section sessions and it was announced that thirty-six papers had been submitted in the competition.

At the second general session, held on the evening of February 23, the large gathering which crowded the Palmer House grand ballroom heard President Roosevelt's radio address to the nation.

At this session, Com. C. Raymond Wells, chief dental officer of the Selective Service System, discussed the rôle of dentistry in the national war effort, making the first announcement that a country-wide program to rehabilitate men rejected for the armed services for dental ailments and minor physical defects had been launched in test programs already under way in Maryland and Virginia.

Commander Wells said:

> Authorization of a rehabilitation program in Virginia and Maryland this month marks the beginning of a long planned nation-wide campaign, and when results of these pilot tests are evaluated, a date for inauguration of the national program will be announced.
>
> The registrant formerly rejected for dental defects or minor physical ailments will be ordered to appear before the local board and be told that he has certain defects but that if they are corrected, he will be considered fit for service or defense industry work. He will be permitted to choose his own family physician or dentist, and when the defects are corrected, the fee will be paid by the federal government.
>
> Physicians and dentists will be asked to give priority of treatment to these men. The plan is designed solely for selective service.

Commander Wells also pointed out that in the majority of rejections because of dental defects the basis of rejection was missing teeth, a condition which he attributed to physicians' and dentists' following the practice of extracting infected teeth rather than striving to save the teeth and treat the infection. Commander Wells said:

> The physician encouraged the dentist to extract teeth in the hope that he would obtain spectacular recovery from some physical illness attributed to focal infection. This, in many cases, was based on flimsy diagnosis. . . . Undoubtedly, the patient must be blamed also because he preferred automobiles and other luxuries to dental care, and too often he seems to have preferred extractions to fillings because of fear or lack of time. . . . Not having any rapid or positive way of preventing dental caries, it is the duty of the dental profession to meet the situation as it exists today and to correct the condition by stopping its progress through practical restorative operative dentistry, with the extraction of carious teeth reduced to a minimum and the insertion of fillings and inlays accelerated to a maximum.

A third point stressed by Commander Wells was that Selective Service is rec-

ommending that more women enter the dental profession and become dental technicians, in order to release more men for service with the armed forces. He said:

Selective Service recommends that more women study dentistry as a vocation because time will prove the need for more practicing dentists in order to make available more manpower for the armed forces. The dental laboratories too should train and employ more women as dental technicians so that more men will be released for duty with the armed forces.

At the same session, Clark G. Kuebler, professor of classical languages at Northwestern University, discussed "Antidotes to Frustration," declaring that the present world war is only part of a vaster struggle—"a fundamental clash of cultures"—and named three ideas which he said must constantly guide the democracies:

1. Freedom never comes through "happenstance," but instead through conscious, assiduous and self-abnegating effort.

2. Citizens of the democracies have definite moral responsibilities imposed upon them by virtue of their citizenship. In place of personal aggrandizement and ruthless individualism must come the highest type of social consciousness; namely, one that does not stifle the individual.

3. World believers in democracy must harken back to the basic idealism of their philosophy and must believe in it as fiercely as do the totalitarians in their tenets.

A distinctive feature of the Midwinter Meeting, the limited attendance clinics were accorded capacity attendance in most instances. Fifty-five of these clinics were held, as well as 200 general clinics. Sixty papers were read at the scientific sections. Twenty motion pictures were shown.

The Health and Educational Exhibits, displayed on the Palmer House mezzanine, were visited by the public in goodly number. In addition, the Scientific and Technical Exhibits, open only to registered dentists and their friends, were presented in separate divisions.

News accounts of the general sessions and addresses, as well as a number of scientific papers, received considerable attention in the Chicago newspapers and the national press.

BRIGADIER GENERAL FAIRBANK RETIRES

AT the time of the Five State Meeting at Washington, March 9, the retirement from the head of the Dental Corps of the Army of Brigadier General Leigh C. Fairbank was announced by the Surgeon General of the Army. At the same time Surgeon General McIntyre announced the appointment of Brigadier General R. H. Mills to succeed Brigadier General Fairbank.

The retirement of Brigadier General Fairbank came somewhat as a surprise to his many friends in the profession. He was appointed to the head of the Dental Corps four years ago and under his leadership the Dental Corps has greatly improved its status in the Army. The elevation of the status of the Dental Corps was signalized by the elevation of its chief to Brigadier General and the development of the Corps under the capable and dignified guidance of Brigadier General Fairbank has been a source of much satisfaction to his colleagues and has established a dental professional and health status in the Army that will ever reflect the sincerity of purpose and the credit of attainment of its former chief.

COMMITTEE ON LEGISLATION

RECENT COURT DECISIONS

DENTAL PRACTICE ACTS—REVOCATION OF LICENSE FOR FALSE AND MISLEADING ADVERTISING

THE license of the petitioning dentist, Smulson, was suspended for a period of two years by the California Board of Dental Examiners after notice and hearing. The petitioner then filed in the superior court a petition for a writ of mandate to compel the board to vacate its suspension of his license. The superior court gave judgment against him and he made the present appeal to the District Court of Appeal, Second District, Division 1, California.

In his appeal, the petitioner made three contentions, which were considered by the court in order. The first contention was that Section 1680 of the Business and Professions Code, which includes in the definition of unprofessional conduct "the making use of any advertising statements of a character tending to deceive or mislead the public," is too vague and uncertain to enable a dentist to know what is forbidden, and therefore it is unenforceable. The court refused to accept this interpretation on the grounds that the words "tending to deceive or mislead the public" are well known and understood in popular and legal language. The court quoted in support of this view a previous decision on the subject as follows, "It would not be possible to frame a definition of unprofessional advertising which would anticipate in terms every form of advertisement which unscrupulous practitioners might thereafter devise. This being so, it cannot reasonably be held necessary to the validity of the statute that it go further than to state a reasonably definite rule under which all such specific acts might be included. This we think has been done in the terms of the statute so far as the same are now presented for consideration."

The petitioner's second contention was that the accusation which the board filed against him was insufficient to confer jurisdiction upon the board. The accusation is sufficient, said the court, if it is expressed in the language of the statute under which the individual is accused. This rule is subject to the qualification that the language of the statute must be sufficiently explicit to advise a person charged thereunder of the particular kind of unprofessional conduct which it is proposed to prove against him. Here the language of the statute was sufficiently explicit and the accusation goes even further by setting forth a copy of the advertisement used, and characterizing it in the statutory language.

The petitioner's last contention was that there was no evidence before the board to support its finding that the petitioner was guilty of unprofessional conduct. The court refused to agree with this allegation also, stating that the petitioner's advertisements conveyed the distinct impression that the petitioner himself took all impressions in his office, whereas the evidence showed that there were times when the impressions were taken by other dentists in his office. This, said the court, tended to mislead the public in a matter which in the hand bill the petitioner tried to make the public think was important. The hand bill also contained these statements: "You can have your plates and make your first payment 30 days after they are completed by using my no money down easy payment plan"; "Don't Pay Me

One Penny Until You Have Worn My Dental Plates for 30 Days." These are also misleading statements, said the court.

According to the petitioner's testimony, the easy payment plan referred to consisted in taking the patient's note and selling it to a finance company. The date of the first payment was put in the note when the patient made a definite appointment for the work and was fixed so as to be thirty days after the then estimated time for completion. In many cases, the date for the first payment arrived before the plate was completed and it was out of the petitioner's power to extend the time to conform to his statements in the handbill.

These two statements alone are sufficient to support the decision of the board, said the court, and it is unnecessary to mention other parts of the handbill which are claimed to be misleading. Judgment affirmed.—*Smulson v. Board of Dental Examiners,* 118 P 2d 483 (California 1941).

DENTURE BILL PASSED BY HOUSE OF REPRESENTATIVES

MARCH 16, the House of Representatives passed H.R. 6730, the Traynor Bill, without amendment. This is the bill designed to prevent the circumvention of state dental laws by mail order denture concerns. The bill was reported favorably by the House Committee on Interstate and Foreign Commerce, March 11, with the recommendation that it be passed. It was immediately placed upon the Consent Calendar of the House of Representatives.

In the belief that the bill might be considered March 16, the first day on which this was possible under the House rules of procedure, the Committee on Legislation sent the following telegram to all secretaries of states societies March 12:

H.R. 6730, entered by Congressman Traynor, Delaware, in the House of Representatives, seeks to prevent the circumvention of enacted state dental laws by violators situated outside the jurisdiction of the state courts.

This bill, which has just been reported favorably by Committee on Interstate and Foreign Commerce, may be considered by the House on Monday, March 16 or Monday, April 6.

Unless you have already acted, it is imperative that representatives of your state in Congress be immediately advised by telegram of attitude of dental profession in your state as wholeheartedly endorsing this measure and requesting enactment.

The bill applies to improper mail order dental practice.

(Signed) A. B. PATTERSON,
Committee on Legislation,
American Dental Association.

Prompt and effective action on the part of the state dental societies in response to this request undoubtedly contributed greatly to the favorable vote on the bill the first day it came up for action.

March 13, Senator James M. Tunnell, of Delaware, introduced in the Senate a bill having the same provisions as H.R. 6730. This bill, S. 2371, was referred to the Senate Committee on Interstate Commerce and will ostensibly serve as a companion bill to H.R. 6730.

COMMITTEE ON ECONOMICS

X-RAY AND DENTAL PROPHYLAXIS SERVICE IN INDUSTRY

By JAMES M. DUNNING,* D.D.S., New York, N. Y.

ADOPTION of standards for industrial dental service by the American Dental Association at Houston opened the way for study of the component elements of a good industrial service. One of the chief purposes of the standards was the initiation of such a study, and the standards were kept quite elementary and flexible so that the results of the study could be incorporated in future efforts without the handicap of a false start.

The standards gave unqualified endorsement only to dental examination and health educational procedures together with certain matters affecting the study of industrial dental hazards, the keeping of dental records and the selection of personnel. X-ray and prophylactic services were endorsed if subject to the approval of the dental society of the state in which the industrial plant was located. The purpose of this article is to explore somewhat farther these two types of service.

X-RAY SERVICE

If a company wishes to establish any examination service whatever, dental x-ray records are of such importance that their omission eliminates all possible claim of the examination service to being complete. This statement requires no proof for the intelligent professional reader. Aside, however, from their fact-finding efficiency, there are several other attributes which make x-rays peculiarly adaptable to industrial use.

In the first place, x-ray films tell their own story and can be transmitted by the institutional dentist to the private dentist without a definite diagnosis. If it is taken for granted that the majority of the employes of a company can go to private dentists for operative and other treatment procedures, it becomes quite important for the company to distinguish between an examination and a recommendation for treatment. For this reason, a diagnosis, within the strictest meaning of the word, becomes undesirable, since diagnoses and recommendations for treatment are sometimes difficult to separate. To avoid diagnosis, it is possible to tell the patient, for example, that he has "an area of bone destruction" at the apex of a tooth root. This comment is sufficient to send him to the dentist with his x-ray survey, but does not commit the dentist to any diagnosis as to the type of pathosis presented; nor does it commit the dentist to any plan of treatment. The dentist can then complete the work of diagnosis, and, with the patient already in a cooperative frame of mind, undertake whatever treatment is necessary. X-ray findings lend themselves to this sort of double-step interpretation in almost every field of dentistry and they are readily accepted by the patient as a reason for going to his own dentist.

Thus it can be seen that a dental x-ray service is a valuable adjunct to dental health education. The Chicago Dental Society, in starting its industrial diagnostic service a few years ago, chose the dental x-ray film as its chief

*Dental director, Metropolitan Life Insurance Company.

tool. This service, though eventually discontinued for financial reasons, achieved considerable success. At the Metropolitan Life Insurance Company, the value of x-ray service is so much appreciated that 50,000 pictures are taken yearly. It is the belief of the staff that x-ray service almost ranks with prophylactic service as a means of stimulating the working force to seek outside dental treatment from their private practitioners. That the Metropolitan staff do seek private dental treatment to a degree far above the average is shown by the accompanying table. The fact that Metropolitan employes have a much larger number of fillings than even the highest income group studied by the Committee on the Costs of Medical Care is suggestive of greater dental efficiency in the Metropolitan group and is reflected in a lower extraction rate.

FREQUENCY OF CERTAIN DENTAL SERVICES; ANNUAL RATE PER THOUSAND POPULATION

Nature of Service	4,689 Individuals with Annual Family Income of $5,000 and over*	14,874 Home Office Employes, Metropolitan Life Insurance Co., 1940
Fillings and crowns	1,079†	1,705
Extractions	254	199
Dental prophylaxes	360	1,694
X-ray examinations	70	528

*A sample from eighteen states reported by the Committee on the Costs of Medical Care (Publication 26) and analyzed and adjusted by S. D. Collins, principal statistician, U.S.P.H.S. (Pub. Health Rep., 54:629-657, April 1939.)

†Includes bridges.

It should be remembered, of course, that many dental conditions require a series of follow-up x-ray films and the private dentist can easily take these pictures himself.

The subject of bite-wing x-ray films deserves special attention. A series of two or four bitewing pictures of the posterior teeth constitutes one of the simplest x-ray services available to a group of industrial employes without large cost and is particularly important to young adults from a preventive point of view. Bitewing pictures indicate the location and size of proximal cavities already known to exist. They show an appreciable amount of new or previously undiscovered proximal caries. They save the patient from the excess probing necessary when full responsibility for locating proximal caries is allowed to rest upon explorer examination. They furnish the hygienist or examining dentist with a starting point from which to undertake further study of the posterior proximal surfaces. Lastly, they are a psychologic aid to the dentist in that they show him which surfaces require most careful examination, and furnish him with the landmarks which make these surfaces significant.

A final advantage of x-ray service as a whole lies in the permanent record made available for identification purposes. Records of aid in identification are specifically approved in paragraph 3 of the Industrial Standards.

For these reasons, I feel strongly that an x-ray service in industry is so indispensable a part of an examination service and so certain to promote dental treatment by private practitioners that the advantage of the service far outweighs any loss of prerogative the private dentist might incur by not taking the x-ray pictures himself.

DENTAL PROPHYLAXIS SERVICE

Dental prophylaxis is another procedure which is essential to any preventive service and much more closely allied to dental examination than to dental treatment. It is assumed, of course, that prophylaxis implies cleaning procedures on the crowns of the teeth down to the base of the free margin of the gum, excluding all deeper cleaning, which might come under the head of periodontal treatment. The usefulness of prophylaxis as a preventive of caries and periodontoclasia needs no reiteration here, but I wish to record my conviction that the preparation of the mouth, by means of prophylaxis, for thorough dental examination, and the opportunity given by prophylaxis for dental health education, are both vital, even though entirely removed from the treatment value of the prophylaxis, giving prophylaxis its strongest claim to inclusion on any industrial program.

The fact that prophylaxis can often be carried out by a dental hygienist gives this procedure a further advantage in any industrial service, since the hygienist is just enough removed from the sphere of ordinary dental practice to have an air of impartiality as she tells a patient to go to his dentist for treatment. Also prophylaxis is generally regarded as the best excuse for a regular recall system: a device as important in institutional dental service as in private practice. Regular recalls lift the dental service from the realm of mere emergency aid to that of a lasting health service to the employe through his entire period of employment or his entire life.

Thus, as with x-ray service, prophylaxis is more than compensated for in terms of subsequent dental operations performed in private dental offices. This conviction is based in part on the table and in part on numerous individual instances which come to mind. The credit for increased operative treatment sought by Metropolitan employes goes to prophylaxis fully as much as (if not more than) to x-ray service.

LEGAL RESTRICTIONS OFTEN MISINTERPRETED

Some may argue that, in common with other phases of dental treatment, x-ray and prophylactic service are contrary to law in certain states. A preliminary investigation of the subject indicates that in many cases these conclusions are unjustified.

Most state laws are very explicit on the point that "it shall be unlawful for any person or persons to practice dentistry under the name of a corporation, company, association or trade name." This provision is designed to prevent establishment of old style dental parlors, in which a group of dentists (charlatans or otherwise) seek to evade responsibility for their acts by the process of incorporation. If, however, a dentist practices under his own name and exhibits his certificate of registration, there is usually no objection whatever to his being employed by a corporation provided that corporation has taken the necessary legal steps to insure that its charter will permit the practice of dentistry.

In New York State, it is a misdemeanor punishable by fine and imprisonment "to practice dentistry . . . under the name of a corporation, company, association, parlor or trade name." Yet the state law for membership corporations contains provisions by which charters may be arranged to include the practice of medicine and dentistry, provided the application for incorporation bears the approval of the state board of charities. Many corporations for the sole purpose of medical and dental care are thus in existence in New York State and many other corporations organized for other purposes maintain medical and dental services for their employes. The Metropolitan Life Insurance Company is one of the latter, and when its tuberculosis sanatorium was established in 1914, a

special decision of the appellate division of the state supreme court ruled:

It is well within the corporate power (of the Metropolitan Life Insurance Company) to assume as it has done the care and treatment of such of its employes as are afflicted with tuberculosis. . . . The reasonable care of its employes, according to the enlightened sentiment of the age and community, is a duty resting upon it, and the proper discharge of that duty is merely transacting the business of the corporation.

The object of the New York law, therefore, appears to be two-fold: (1) to compel the dentist to use his own name when he practices, whether that practice is in his own office or upon the premises of a corporation, and (2) to restrict corporation practice to work undertaken without profit, either for the corporation's own employes or for groups deserving of charity.

The law of the State of Illinois is almost exactly similar. Section 18a reads:

No corporation shall practice dentistry or engage therein or hold itself out as being entitled to practice dentistry . . . provided that nothing contained in this act shall prohibit a corporation from employing a dentist or dentists to render dental service to its employes, provided that such dental services shall be rendered at no cost or charge to the employes; nor shall it apply to corporations or associations in which the dental services were originated and are being conducted on a purely charitable basis for the worthy poor. . . .

In New Jersey, the usual restriction on the practice of dentistry under the name of a corporation is followed, in Chapter 202, by a paragraph on clinics, infirmaries and hospitals, wherein these institutions are defined as including "any company, corporation, firm association or partnership engaged in any legal enterprise within the state . . . which may maintain its own or their own privately maintained 'clinic,' 'infirmary' or hospital" for the dental care of their employes, provided in such cases the establishment shall be approved by the state board of registry and examination in Dentistry. . . ." A further exception is made in favor of philanthropic or charitable institutions.

From these examples, it seems probable, therefore, that states which entirely prohibit industrial dentistry are in a small minority, if indeed any exist at all. I see no reason why the recommendation of the American Dental Association on this subject, compatible as it would be with the majority of state practices, should be considered as an invitation to break the law in any states where the recommendations are incompatible. On the other hand, if the attitude of the American Dental Association should lead any states to liberalize their dental laws through proper legislative process, the result could hardly be condemned by any one.

SUMMARY

Dental x-ray and dental prophylactic services are more closely related to dental examination than to dental treatment, and they both increase dental treatment in private offices to a degree that far outweighs any loss of prerogative the private dentist might suffer from not performing these services himself. Therefore, and entirely aside from their inherent preventive value, it would seem that both these procedures merit unqualified endorsement by the American Dental Association in its Standards for Industrial Dental Service. A preliminary investigation of legal restrictions has indicated no reason why such endorsement should not be made.

SURVEY OF THE INCOME OF THE DENTAL PROFESSION BY THE AMERICAN DENTAL ASSOCIATION AND THE DEPARTMENT OF COMMERCE

As has been announced, the Committee on Economics of the American Dental Association is making a survey of the economic status of the dental profession. This survey was planned as a joint endeavor of the American Dental Association and the Department of Commerce.

The mailing of the questionnaire from which the information is to be obtained for the study was begun about two weeks ago, and is now almost completed. The questionnaire is being sent to all practicing dentists, both members and nonmembers of the American Dental Association. The returns are already large, and there is every indication that the members of the profession are cooperating whole-heartedly in the survey.

The question has been raised by some as to whether the questionnaire might be utilized for any purpose other than that of computing the "average income" for large groups in the dental profession. The Committee on Economics gives assurance that this is the sole purpose of the survey and that no governmental agency other than the Department of Commerce will have access to the individual returns.

The dentist is not asked to sign the questionnaire and will remain completely anonymous. A few have inquired regarding the significance of the number appearing on the lower margin of the questionnaire. (This (2.11281) is merely a form number, being identical on all of the questionnaires.

If the American Dental Association is to represent and serve organized dentistry intelligently, it is essential that the Association have at its disposal exact information on a variety of subjects relating to the practice of dentistry. Information regarding the economic status of various sections of the dental population is of vital importance in this respect. Consequently, the Committee on Economics urges the dentist to cooperate.

The Committee is fully aware that, during this emergency period, the members of the dental profession have been called upon to fill out a number of questionnaires and has no intention of unnecessarily burdening the members of the profession at this time. The plans for the survey were laid several months ago, before the war emergency arose. Since the plans were completely developed, and with considerable expenditure of time and money, it was not deemed advisable to abandon the survey at this late date.

Participation in this survey is entirely a voluntary matter. While the committee would greatly appreciate the cooperation of the dentist, it does not urge or expect a response from the dentist who feels that he has been called upon to give an undue amount of his time to the filling out of questionnaires.

Any questions regarding the questionnaire will be answered by the Secretary of the Committee.

R. M. WALLS, D.D.S., *Chairman.*
M. L. DOLLAR, *Secretary.*

THE SCIENTIFIC AND HEALTH EXHIBITS OF THE AMERICAN DENTAL ASSOCIATION

THE Scientific and Health Exhibits, which have gradually developed from a minor adjunct to the American Dental Association meetings to a major attraction, will take on a new significance this year. Added to the usual colorful exhibits of the educational institutions and individuals, there will be the olive drab and navy blue atmosphere of our armed forces. Things that were formerly of only passing interest to most members of organized dentistry have become highly essential to the very existence of our mode of life. These important new apparatus, instruments and methods will be readily understood when observed and sketched in the Scientific Exhibits in Boston's historic Mechanics Hall.

Not only are the dental activities of the Army and the Navy now of great importance, but even research and teaching activities are in a process of transition. The large number of young men rejected for army duty because of dental defects reveals a need for wide improvements in methods of dental care and their administration. The teaching, research and health exhibits will reflect what American dentistry is contributing to American defense. The dentist will find developments of value to him, to his patients and to his community in the Scientific and Health Exhibits. Planning his time to allow for visits to these exhibits will be to his great advantage.

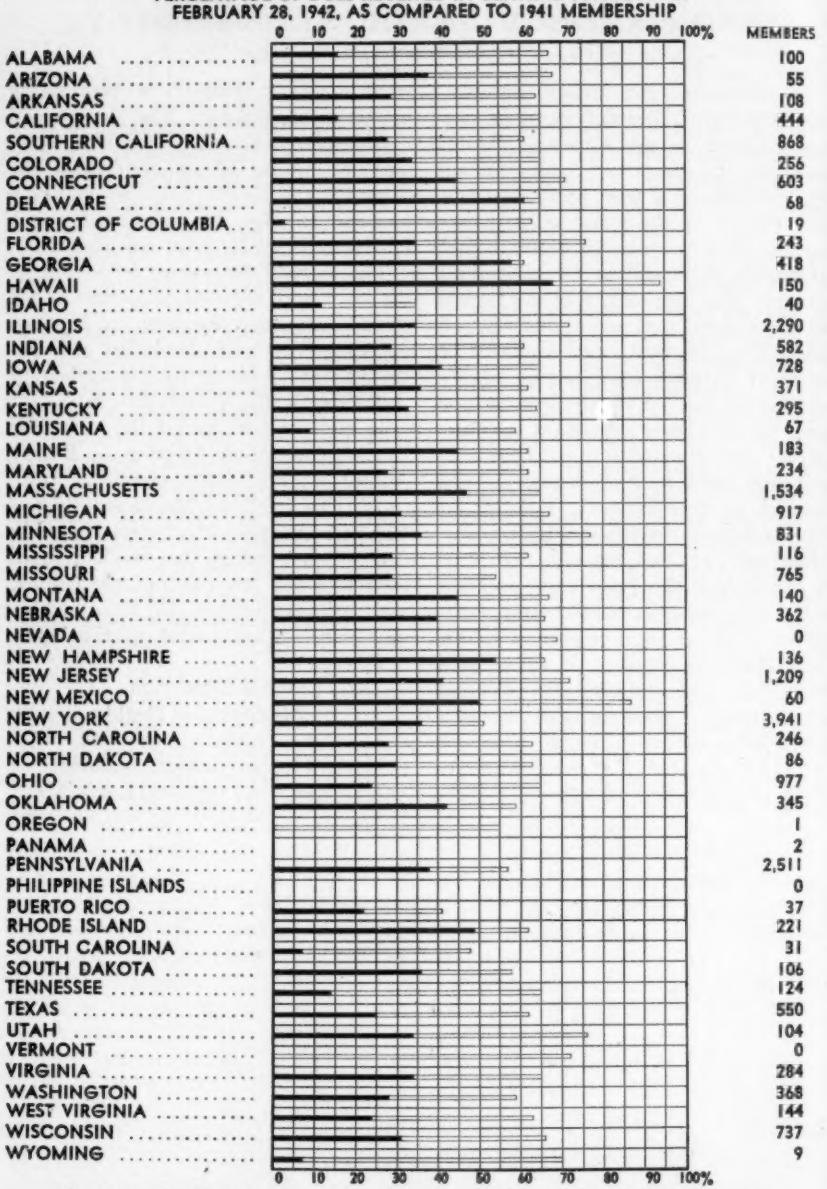
The increase in interest evidenced by the large and attentive audiences at the Visual Education Program at Houston encouraged the exhibitors to redouble their efforts to bring the latest advances to the dentist this year in Boston.

In planning to attend the American Dental Association Meeting in Boston, August 24-28, 1942, plenty of time should be saved for the Scientific and Health Exhibits in Mechanics Hall. The dentist who wished that he had saved time to see a few more of the exhibits and motion pictures in Houston last year will not make that mistake again at Boston.

LEO F. MARRÉ, *Chairman,*
Scientific and Health
Exhibits Committee,
Missouri Theatre Building,
St. Louis, Mo.

Membership Page

PERCENTAGE OF DUES RECEIVED IN CENTRAL OFFICE AS OF FEBRUARY 28, 1942, AS COMPARED TO 1941 MEMBERSHIP



Percentage based on dental population figures supplied by the State Society Secretaries.

1942 percentage. 1941 percentage.

OBITUARY

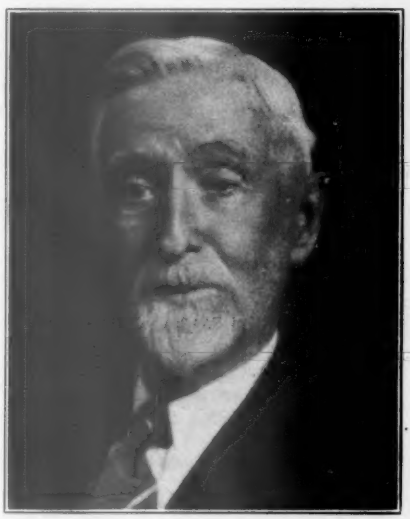
LOUIS PHILIP HALL, D.D.S.
(1860-1941)

LOUIS PHILIP HALL was born in Toledo, Ohio, in 1860. In his early years, his family moved to Ann Arbor and settled in the then southwestern part of the city. They bought a tract of land in that part of town and developed it during later years. Cambridge Road, formerly known as Israel Avenue, was named after Dr. Hall's father, and Olivia Avenue after his mother.

Dr. Hall attended the public schools and was graduated from the Ann Arbor High School in 1879. He entered the literary department of the university, where he spent one year. He then engaged in business for six years, and later entered the college of dentistry of the university, graduating in 1889. His first appointment in the dental college was that of assistant to Dr. Watling in the clinic, in 1889. In 1897, he was made instructor in dental anatomy, operative technic and clinical dentistry. Two years later, he became assistant professor, and, in 1903, professor of operative and clinical dentistry. This position he held until 1928, when he retired as emeritus professor of operative dentistry.

During these years, Dr. Hall was an ardent and enthusiastic teacher, acting as an inspiration to hundreds of dental students to attain the highest ideals in dental art and practice. He was especially well known as a gold foil operator and attained a high degree of skill in the practice and teaching of this art. In addition to his school duties, he carried on a part-time general practice in an office on North University Avenue.

Dr. Hall was interested in community welfare, and, through his activities in this regard, he became known as an outstanding citizen in his community. From 1922 to 1936, he participated in every Community Fund campaign, acting as president of that organization in 1936. During the World War, he was a leader in Red Cross work and chairman of the committee which enlisted the first three groups for army ambulance service abroad. For his distinctive work in this field, he received the Pro Patria pin. He was also active in the Red Cross reconstruction work following a tornado



LOUIS PHILIP HALL, D.D.S.
1860-1941

in Washtenaw County. Dr. Hall was an officer and leader in St. Andrew's Episcopal Church. In recognition of his service, a testimonial dinner was given by the dental profession, November 16, 1937, and in 1938 the dental class of 1916 presented a portrait of Dr. Hall to the university, which now hangs in the dental school clinic. The citizens of Ann Arbor also gave a dinner to him in May 1938, at which his many civic contributions were lauded.

Dr. Hall died December 19, 1941. Elizabeth Douglas Hall, whom he married in 1885, two sons, Douglas Hall, now living in Flossmoor, Ill., and Louis P. Hall, Jr., of Morristown, N. J., and one daughter, Mrs. J. R. Hayden, of Ann Arbor, survive, as well as twelve grandchildren and five great grandchildren. A third son, Richard N. Hall, was killed in France on Christmas Day, 1915, while serving as a volunteer in the American Ambulance Corps with the French Army.

Dr. Hall will long be remembered by the many graduates of dentistry whom he taught and by a host of citizens of his community.

RUSSELL W. BUNTING.

DEATHS

BEY, JOHN E., Perryville, Mo.; Washington University School of Dentistry, 1900; died January 10.

EISENHART, WILLIAM S., York, Pa.; University of Pennsylvania School of Dentistry, 1896; died recently; aged 67.

GOLDBERGER, ALFRED, New York, N. Y.; New York College of Dentistry, 1913; died January 9; aged 49.

KETTLER, WILLIAM, Milwaukee, Wis.; Marquette University Dental School, 1901; died November 29; aged 64.

LINGER, JOSEPH M., Wauwatosa, Wis.; died October 5; aged 69.

MOYER, JACOB F., Indianapolis, Ind.; Indiana University School of Dentistry, 1899; died January 17; aged 40.

NAFTEL, JAMES ERNEST, Bessemer, Ala.; Southern Dental College, 1916; died January 21; aged 46.

ROONEY, T. J., Kenosha, Wis.; Marquette University Dental School, 1924; died September 27; aged 45.

WEISS, LESLIE L., Chesterton, Ind.; Northwestern University Dental School, 1921; died January 20; aged 47.

WILSON, EVERETT L., Port Washington, N. Y.; University of Pennsylvania School of Dentistry, 1915; died December 1; aged 48.

DEATH OF DR. S. C. G. WATKINS

It is with much sadness that we announce the sudden death of Dr. S. C. G. Watkins of Montclair, N. J.

An obituary notice of Dr. Watkins will be published in an early issue of THE JOURNAL.

CURRENT LITERATURE

Studies on the Effect of Indigestion of Citrus Fruit on the Oral Microbial Flora

By A. J. Florestano, J. E. Faber and L. H. James

Of 131 male inmates of the District of Columbia Penal Farm who had been on the regular prison diet for at least one year, sixty-four men, as a control group received the usual diet, while a second group, of sixty-seven men, received in addition one-half grapefruit at each of the three daily meals. Bacteriologic examination of specimens of saliva obtained at regular intervals showed that the average bacterial count was reduced 47 per cent after the grapefruit had been eaten daily for a period of one month. This seems to indicate that citrus fruits possess some factor or factors inhibitory to oral bacteria. It appears that the reduction in number of the oral bacteria was due more to local than to systemic changes that may have resulted from use of the fruit. The ingestion of citrus fruit may possibly become an important factor in control of certain oral diseases.—*J. D. Res.*, 20:521, December 1941.

James T. Ginn.

Abrasion of Cementum and Dentin by Modern Dentifrices

By R. S. Manly

Ten abrasive-containing dentifrices and one liquid dentifrice were tested in duplicate for their abrasion of cementum and dentin by a procedure designed to reproduce oral conditions. Photographs and measurements of the tooth are presented which show the effects of use of these materials after 86,400 brush strokes (probably the equivalent of six years of average daily brushing). The average abrasion of cementum and dentin by all the abrasive-containing pastes and powders tested ranged from 0.2 to 2.1 mm. In contrast, the liquid dentifrice failed to produce measurable abrasion when tested in an identical manner on the reverse surfaces of the same teeth.—*J. D. Res.* 20:583, December 1941. James T. Ginn.

Pulp Stones and Hypercementosis in Arthritis

By Sidney Sorrin

In a series of forty-eight non-arthritic and forty-six arthritic cases considered in this study, only those patients with a minimum of fifteen teeth in the mouth were included. The non-arthritic patients showed a slightly higher incidence of pulp stones and a lower incidence of hypercementosis than did the arthritic. The higher incidence of hypercementosis in the arthritic group may be the result of inclusion of one case in which all twenty-two teeth showed this condition. It was concluded that no relationship between either pulp stones or hypercementosis and arthritis existed in the cases studied.—*J. D. Res.*, 20:543, December 1941.

James T. Ginn.

Odontoblasts in the Dentinal Tubuli

By Balint Orban

Odontoblasts were observed in the dentinal tubuli in the region where forceps had been applied to the surface of the tooth during the process of extraction. In corresponding areas of the pulp, most of the odontoblasts were absent. It was believed that the cells entered the dentinal tubuli by some mechanical means. Possibly the dentinal tubules shrink as a result of the surface injury, and so pull the corresponding odontoblasts into the tubuli. There may be a slight compression of the dentin and pulp, producing a sucking or pumping action upon the odontoblasts.—*J. D. Res.*, 20:553, December 1941.

James T. Ginn.

Extensive Alopecia Areata of Dental Origin

By J. D. Grace

Marked improvement of extensive alopecia of about three and one-half years' duration, involving the scalp, eyebrows, beard and body (except pubic) hair of an otherwise normal 29-year-old man was associated with extraction of several teeth over

a period of one and one-half years. A year and a half after the extractions, two symmetrical areas of alopecia developed on the right and the left side of the occiput. Extraction of one right and one left bicuspid tooth suggested an ipsilateral relation between these teeth and the areas of alopecia. The ten extracted teeth were vital, but all contained large silver amalgam fillings, which, in roentgenograms, appeared to encroach on the pulp chambers and were not properly insulated by cement linings. Negative cultures were obtained from the last two extracted. It was suggested that the fillings caused trophic disturbances by irritating the dental pulps, although there were no objective or subjective symptoms of dental disease.—*Arch. Dermat. & Syph.*, 45:349, February 1942.

PETER P. DALE.

Lichen Planus Confined to the Oral Cavity in Twins

By S. Epstein

FAMILIAL lichen planus, a rarity, is reported in two adult males, identical twins. The clinical lesions were nearly identical and were confined to the oral cavity. The mucous membranes of the cheeks were almost completely covered with numerous confluent reticular lesions. The lesions of the tongue and lip were oval and annular. Involvement of the lip of one of the twins constituted the only departure from the usual oral manifestations of the disease.—*Arch. Dermat. & Syph.*, 45:382, February 1942.

PETER P. DALE.

Source of Infection in Actinomycosis

By JOHN SLACK

TONSILS from routine tonsillectomies in two distinct age groups, fifty from children 1 to 15 years old and fifty from adults 15 to 63, were collected and the presence of anaerobic actinomycetes was determined. Without selection as to age, the parasites were found in 14 per cent of the primary mixed cultures, and pure cultures were obtained from 11 per cent of the tonsils. Twelve per cent of the tonsils contained *Monilia albicans*. Pure cultures of an actinomycetic strain identical to that isolated from the tonsils were obtained in 12 per cent of 100 samples of pyorrhea pus. Eighteen per cent of the primary mixed cultures contained actinomycetes, but *Monilia albicans* was demonstrated in only one specimen. Cultures from a case of human actinomycosis and a pyorrhea case were identical. Experimental actinomycosis was produced in four rabbits and one guinea-pig inoculated with actinomycetes from pyorrhea pus. The endogenous theory of the source of infection in actinomycosis is supported. It appears that actinomycetes grow in the mouth and become pathogenic under certain unknown conditions. —*J. Bacteriol.*, 43:193, February 1942.

H. B. MCCAULEY.

Studies on Lactobacilli. III. Relationship of Immunological Specificity and Fermentative Capacity

By R. W. HARRISON

A COLLECTION of 303 cultures of oral lactobacilli was divided into two groups on the basis of fermentation reactions. Group A strains, of which there were 224, fermented sorbitol and mannitol and produced acid in milk. They all coagulated milk in seven days or less, except for eight strains, which were not effective within fourteen days. Group B strains, seventy-nine of them, produced acid in milk, but did not coagulate it. Neither did they ferment sorbitol or mannitol.

These two groups were found to fall into two immunologic groupings. Carbohydrate obtained from three-fourths of group A bacteria precipitated this type specifically with antiserum of rabbits immunized for from six to two months with group A cultures. Group B strains behaved as immunologically heterogeneous strains.—*J. Infect. Dis.*, 70:69, January 1942.

PETER P. DALE.

Calculus in Wharton's Duct in a Boy Aged Eight

By PHILIP WESTHEAD

SALIVARY calculi occur more commonly in persons of middle age, and more frequently in males than in females. In this case, a boy, 8 years of age, with a healthy mouth except for one carious tooth, showed a hard swelling near the end of Wharton's duct on the right side. The patient experienced no pain either before or during meals. The saliva was more viscid than is normal. A diagnosis of calculus in the duct was made.

Under local anesthesia, the duct was

opened and the calculus removed. The incision healed without incident.—*Brit. D. J.*, 72:39, January 15, 1942.

V. H. POWELL.

Dental Fluorosis and Caries in London Children

By M. M. MURRAY and D. C. WILSON

EVIDENCE obtained in an examination of 1,400 evacuated London school children suggested that moderate mottling of the teeth was associated with greater immunity to dental caries. All the children examined had good general nutrition. None showed abnormal enlargement of the thyroid gland. This evidence supports that of a similar less detailed study previously made upon 1,048 Somerset children.

Fluorine analyses of the three main sources of the London water supply were as follows:

Filtered Thames	0.10 p.p.m.
Filtered Lee	0.15 p.p.m.
Filtered New River	0.32 p.p.m.

However, in a report from the Metropolitan Water Board for 1936, the highest figure among other subsidiary sources was 1.2 parts per million. It is suggested that low levels of fluorine in water taken during tooth development can significantly lower the incidence of caries.—*Lancet*, 1:98, January 24, 1942.

V. H. POWELL.

Enamel Hypoplasia in Idiopathic Epilepsy

By R. SPITZER

OF sixty-five epileptics presenting at least several groups of teeth belonging to the same developmental period, thirty-three showed enamel defects of the permanent dentition. None of the patients suffered from congenital syphilis. The defects were of the same character in every case, differing only in size or distribution. Changes in the enamel affected teeth belonging to the same embryonic developmental period were identical in locality, form and intensity in the fellow teeth. Since the enamel organ originates from the same germinal layer as nervous tissue, it is possible that some lesion of or damage to the ectodermal layer is responsible for both conditions. However, the two disorders may only be associated rather than intimately related in their pathogenesis.—*Brit. M. J.*, 1:110, January 24, 1942.

J. E. GILDA.

Tumors of the Salivary Glands, Benign and Locally Malignant

By H. O. SINGLETON

IN a series of sixty-five cases comprised of mixed, malignant and metastatic tumors of the salivary glands, the average age at onset for all the primary tumors was 38 years. Of these, the onset for mixed tumors averaged 31.5 years; for malignant tumors, 52.3 years. The postoperative duration of the mixed tumors averaged 5.4 years; of the malignant tumors, 1.24 years. Mixed tumors occurring in the parotid gland may, in some cases, demand conservative surgical measures, but usually warrant a more radical procedure. Radical measures are advocated for carcinoma of the parotid gland.—*Surg. Gynec. & Obst.*, 74:569, February 1942.

J. E. GILDA.

Use of Vermilion Bordered Flaps in Surgery About the Mouth

By B. CANNON

THE vermilion bordered lip flap was first described by Estlander in 1872. Since that time, there have been several modifications, but the primary principle, which consists of carrying a large direct vermilion bordered flap on a narrow pedicle with a single nutrient artery, has remained unaltered. It is useful in repairing the lip after a wide excision for carcinoma, obviating sacrifice of normal tissue and the widespread relating incisions in the cheek. It is also useful for the secondary correction of hairlip deformities, both in securing a better balance between the upper and the lower lip and in correcting deficiencies in the floor of the nose.—*Surg., Gynec. & Obst.*, 74:458, February 1942.

J. E. GILDA.

Inflammation of the Salivary Glands

By A. L. BECK

MUMPS, uveoparotid fever and Mikulicz's syndrome represent several specific types of inflammation. Certain drugs may also cause inflammation of these glands. Parotid infection can be considered as a manifestation of infection of the cervical fascia, which may be primary and limited to the salivary glands

or may be secondary to a systemic disease. Three important types of acute infection exist: (1) acute parotitis associated with deep neck infections, (2) acute exacerbation of the chronic inflammation associated with calculus formation and (3) acute parotitis occurring during the course of a systemic disease or following trauma to abdominal or pelvic organs.—*Surg. Gynec. & Obst.*, 74: 604, February 1942.

J. E. GILDA.

Roentgenographic Findings of Edentulous Areas

By C. A. SCHLACK and J. O. BOOTH

IN a study of 1,075 roentgenograms of edentulous areas taken from the files of the U. S. Naval Dental School, no disease was found in approximately 94 per cent. Areas showing the sockets of recently extracted teeth or pictures of completely edentulous jaws were not considered.—*Am. J. Orthodontics*, 28:73, February 1942.

H. B. MCCAULEY.

Etiology of Acute Infectious Gingivostomatitis (Vincent's Stomatitis)

By W. C. BLACK

A STUDY was made to determine the causative agent in twenty-three cases of acute infectious gingivostomatitis in children, mostly under 6 years of age. There were twenty-two controls, thirteen having oral lesions not typical of acute gingivostomatitis, and nine normal, healthy children.

Direct inoculation of the corneas of white rabbits with material from the oral lesions of acute gingivostomatitis produced a specific herpetic keratoconjunctivitis, indicating the presence of the virus of herpes simplex in the lesions. The corneal infection was readily transferred from animal to animal, and, after recovery, the rabbits were immune to virulent strains of herpes simplex. In no instance did material from the controls' mouths produce typical herpetic keratoconjunctivitis in the rabbit. By satisfying accepted criteria necessary to prove virus etiology, it was concluded that acute Vincent's infection is a herpetic stomatitis in which the fusiform bacillus and the spirochete of Vincent have no primary or secondary etiologic role.—*J. Pediat.*, 20:145, February 1942.

H. B. MCCAULEY.

Investigations into the Early Effects of Various Filling Materials on the Human Pulp

By E. B. MANLY

THE nature and the degree of reaction of the human pulp to filling materials, i.e. silver, amalgam, silicate cements, zinc oxide and eugenol, and copper oxyphosphate cement, were investigated. The subjects were orthodontic patients in whom the extraction of sound premolars was required. Cavities were prepared on the gingival third of the buccal surfaces with the field isolated from the saliva. After from two to eight weeks, the teeth were extracted, fixed, decalcified, embedded in paraffin and prepared for study in serial sections. The use of silver amalgam caused calcification of the odontogenic zone, deposition of secondary dentin, reduction and degeneration of odontoblasts and increased vascularity of the pulp in three weeks. The use of silicate cements had a more serious type of reaction, with a marked toxic effect on the pulp. Only slight reactions occurred in the pulps of teeth filled with zinc oxide and eugenol. The presence of copper oxyphosphate cement caused widespread destruction of the pulp under a deep filling.—*D. Rec.*, 62:1, January 1942.

H. B. MCCAULEY.

Phosphate Equilibrium Between Plasma and Saliva

By C. P. BARNUM and W. D. ARMSTRONG

FOUR grams of sodium radiophosphate (42,000,000 Geiger-Müller counts) was dissolved in 100 cc. of water and administered by stomach tube to a 52-year-old woman with advanced carcinoma of the breast. Salivation was increased by the chewing of paraffin and specimens were collected over twenty-six-minute periods, one, three and twenty-four hours after administration of the phosphate. A sample of venous blood was obtained midway of the three-hour collection. The expected equilibrium between plasma and saliva phosphorus as indicated by the specific activities (percentage of administered radiophosphorus per milligram of total phosphorus) of the samples was not found. A possibility exists that the specific activity of the plasma was still increasing when the blood was drawn.—*Proc. Soc. Exper. Biol. & Med.*, 49:40, January 1942.

H. B. MCCAULEY.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Boston, Mass., August 24-28.

AMERICAN DENTAL ASSOCIATION, Boston, Mass., August 24-28.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS, Boston, Mass., August 20-22.

CLEVELAND (OHIO) DENTAL SOCIETY, May 4-6.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month, from October to June at the United States Public Health Service Auditorium, Washington.

NATIONAL BOARD OF DENTAL EXAMINERS, May 4-5.

NEW YORK SOCIETY OF ORTHODONTISTS, New York, November 9-10.

NEW YORK STATE SOCIETY OF DENTISTRY FOR CHILDREN, New York, May 15.

OHIO STATE UNIVERSITY DENTAL COLLEGE ALUMNI MEETING, Columbus, April 15-16.

OLD DOMINION DENTAL SOCIETY, Danville, Va., April 6-7.

ONTARIO DENTAL ASSOCIATION, Toronto, May 18-21.

CENTENNIAL OF TOLEDO DENTISTRY AND CLINIC DAY, Toledo, Ohio, April 29.

WESTCHESTER DENTAL ASSISTANTS SOCIETY, Mt. Vernon, N. Y., April 14.

WESTERN RESERVE DENTAL ALUMNI ASSOCIATION FIFTIETH ANNIVERSARY CELEBRATION, Cleveland, Ohio, June 8.

STATE SOCIETIES

April

Alabama, at Birmingham (7-9)
California, at Sacramento (13-15)
Connecticut, at Bridgeport (29-May 1)
Kansas, at Wichita (26-29)
Michigan, at Detroit (20-22)
Mississippi, at Jackson (20-22)
Oklahoma, at Tulsa (19-22)
Texas, at San Antonio (26-30)
Virginia, at Roanoke (6-8)

May

Arkansas, at Little Rock (18-20)
Georgia, at Savannah (17-20)
Illinois, at Springfield (11-14)
Indiana, at Indianapolis (18-20)
Iowa, at Des Moines (4-6)
Louisiana, at Lake Charles (7-9)
Maryland, at Baltimore (4-5)
Missouri, at St. Louis (24-27)
Montana, at Butte (7-9)
Nebraska, at Lincoln (11-13)
New Jersey, at Atlantic City (6-8)
New York, at New York (11-15)
North Carolina, at Greensboro (11-13)
North Dakota, at Jamestown (11-13)
South Carolina, at Greenville (4-6)
South Dakota, at Sioux Falls (13-15)
Tennessee, at Chattanooga (11-14)
Vermont, at Burlington (20-21)
West Virginia, at Clarskburg (18-20)

June

Colorado, at Colorado Springs (18-20)
Idaho, at Lewiston (8-10)
Wyoming, at Laramie (22-24)

STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 15. W. A. Wood, Merchants National Bank Bldg., Secretary.

Arizona, at Phoenix, June 29-July 2. R. K. Trueblood, 25 N. Second Ave., Glendale, Secretary.

California, at San Francisco, May 25, and at Los Angeles, June 15. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Connecticut, at Hartford, June 23-27. Clarence G. Brooks, 302 State St., New London, Recorder.

Delaware, at Wilmington, June 16-19. Charles R. Jefferis, Medical Arts Bldg., Secretary.

Florida, at Jacksonville, June 22-26. H.

B. Pattishall, 351 St. James Bldg., Jacksonville, Secretary.

Kentucky, at Louisville, June 9-12. Leon M. Childers, 1312 First Nat'l Bank Bldg., Lexington, Secretary.

Maine, at Augusta, June 22-24. Carl W. Maxfield, 31 Central St., Bangor, Secretary.

Massachusetts, June 15-18. Francis M. Cahill, 413-N State House, Boston.

Montana, at Helena, second Monday in July. D. H. McCauley, Laurel, Secretary.

New Jersey, June 29-July 4. W. A. Wilson, 150 East State St., Trenton, Secretary.

New Mexico, at Santa Fe, June 15-18. J. J. Clarke, Artesia, Secretary.

North Carolina, at Raleigh, June 22. Wilbert Jackson, Rich Bldg., Clinton, Secretary.

North Dakota, at Fargo, June 13-16. L. I. Gilbert, 401 Black Bldg., Fargo, Secretary.

Ohio, at Columbus, June 22. Earl D. Lowry, 79 E. State St., Columbus, Secretary.

Pennsylvania, at Philadelphia and Pittsburgh, June 16-20. Reuben E. V. Miller, 61 N. Third St., Easton.

South Carolina, at Columbia, June 11-13. T. C. Sparks, 1508 Washington St., Columbia, Secretary.

Texas, at Houston, June 15-19. Carl C. Hardin, Jr., 604 Littlefield Bldg., Austin.

Vermont, at Montpelier, June 22-24. C. I. Taggart, 139 Bank St., Burlington, Secretary.

West Virginia, at Charleston, June 29-July 2. R. H. Davis, 510 Goff Bldg., Clarksburg, Secretary.

Wisconsin, at Milwaukee, June 1-5. Stephen F. Donovan, Tomah, Secretary.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

THE eighteenth annual session of the American Dental Assistants Association will be held in Boston, Mass., August 24-28. For further information, address

AILEEN M. FERGUSON,
General Secretary,
709 Centre St.,
Jamaica Plain, Mass.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

THE twenty-fourth annual meeting of the American Society of Oral Surgeons and Exodontists will be held in Boston, Mass., August 20-22, with headquarters in the Copley-Plaza Hotel.

HARRY BEAR, *Secretary,*
410 Professional Bldg.,
Richmond, Va.

CLEVELAND DENTAL SOCIETY

THE annual Spring Clinic Meeting of the Cleveland (Ohio) Dental Society will be held May 4-6 at the Statler Hotel, Cleveland.

ALBIUN F. SADD, *Chairman,*
Publicity Committee,
562 Rose Bldg.,
Cleveland, Ohio.

NATIONAL BOARD OF DENTAL EXAMINERS

THE National Board of Dental Examiners will hold its next session for the examination of candidates in Parts I and II, May 4-5, in schools where there are five or more candidates. For further information and application blanks, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven, Conn.

NEW YORK SOCIETY OF ORTHODONTISTS

THE next meeting of the New York Society of Orthodontists will be held at the Waldorf-Astoria Hotel, New York, November 9-10.

NORMAN L. HILLYER, *Secretary,*
Professional Bldg.,
Hempstead.

NEW YORK STATE SOCIETY OF DENTISTRY FOR CHILDREN

THE next annual meeting and luncheon of the New York State Society of Dentistry for Children (component of the American Society of Dentistry for Children) will be held at the Pennsylvania Hotel, New York, May 15, at 12:30 p.m. The speaker will be Jack M. Wisan, president-elect of the American Society of Dentistry for Children. The Section on Dentistry for Children of the Second District Dental Society will act as host to the out-of-town members. After the meeting, there will be a tour of the Guggenheim Clinic and School for Dental Hygienists. John Oppie McCall, director. will discuss "Dental Diseases in Children's Mouths."

CARROLL M. LARSON, *Secretary,*
228 Flatbush Ave.,
Brooklyn.

OHIO STATE UNIVERSITY ALUMNI MEETING

THE Ohio State University Dental College Alumni will meet for a two-day educational and scientific program, April 15-16. All Ohio dentists are invited to attend. Invitations, reservation cards and programs will be mailed to the Ohio State University alumni. Graduates of other schools wishing to receive them will be supplied on communication with the Dental College, Ohio State University.

FRANK C. STARR, *Chairman of Publicity.*

OLD DOMINION DENTAL SOCIETY

THE Twenty-Ninth Annual Spring Meeting of the Old Dominion Dental Society will be held at Danville, Va., April 6-7. Following are the officers: president, J. Conrad Wilson, Richmond; president-elect, O. Eugene Dabney, Newport News; secretary, L. V. Ragland, South Boston; treasurer, J. A. Jackson, Charlottesville; director for publicity, L. A. Fowlkes, Newport News.

L. A. FOWLKES, *Publicity Director,*
2510 Jefferson Ave.,
Newport News, Va.

ONTARIO DENTAL ASSOCIATION

THE seventy-fifth annual convention of the Ontario Dental Association will be held at the Royal York Hotel, Toronto, May 18-21. Dentists from the United States and all parts of Canada will be welcome.

EDMUND A. GRANT, *President.*

CENTENNIAL OF TOLEDO DENTISTRY AND CLINIC DAY

THE Centennial of Toledo Dentistry and Clinic Day, sponsored by the Toledo Dental Society, will be held in the Secor Hotel, Toledo, April 29. The following will present papers and clinics: Edward L. Ball, Cincinnati, Ohio, president of the Ohio State Dental Society; I. Franklin Miller, Pittsburgh, Pa., and Mr. James Robinson, Chicago, Ill. Members of the Toledo Dental Society and the Toledo Dental Assistants Association will present table clinics. This will be an all day and evening meeting. All members of the American Dental Association are invited.

PAUL G. WELLES, *General Chairman,*
2493 Collingwood Blvd.,
Toledo, Ohio.

WESTCHESTER DENTAL ASSISTANTS SOCIETY

THE Westchester Dental Assistants Society will meet April 14 at 8 p.m. to nominate officers for the year 1942-1943. All dental assistants are invited to a demonstration of a step-by-step gold inlay technic by Mr. George Fine, after nomination of officers. Place: Edison High School, 60 S. Third Ave., Mt. Vernon, N. Y.

SILVIA MERRELL,
Publicity Chairman,
101 Park Ave.,
Mt. Vernon, N. Y.

WESTERN RESERVE DENTAL ALUMNI ASSOCIATION

THE Western Reserve Dental Alumni Association announces the Fiftieth Anniversary Celebration, June 8. The alumni clinic, class reunions and dinner will be held at the Mid Day Club.

JOSEPH R. GOULD, *Secretary,*
630 Rose Bldg.,
Cleveland, Ohio.

ALABAMA DENTAL ASSOCIATION

THE next annual meeting of the Alabama Dental Association will be held April 7-9 at the Tutwiler Hotel, Birmingham.

GEORGE W. MATTHEWS, *Secretary,*
905 Protective Life Bldg.,
Birmingham.

ARKANSAS STATE DENTAL ASSOCIATION

THE next annual meeting of the Arkansas State Dental Association will be held at Little Rock, May 18-20.

I. M. STERNBERG, *Secretary,*
Merchants Bank Bldg.,
Fort Smith.

CALIFORNIA STATE DENTAL ASSOCIATION

THE California State Dental Association will hold its next annual meeting April 13-15 in Sacramento.

FREDERICK T. WEST, *Secretary,*
450 Sutter Street,
San Francisco.

COLORADO STATE DENTAL ASSOCIATION

THE next annual meeting of the Colorado State Dental Association will be held at the

Broadmoor, Colorado Springs, June 18-20.

C. K. PHILLIPS, *Secretary,*
529 Majestic Bldg.,
Denver.

CONNECTICUT STATE DENTAL ASSOCIATION

THE next annual meeting of the Connecticut State Dental Association will be held April 29-May 1 at the Hotel Stratfield, Bridgeport.

EARLE S. ARNOLD, *Secretary,*
37 Linnard Road, W.,
Hartford.

GEORGIA DENTAL ASSOCIATION

THE next annual meeting of the Georgia Dental Association will be held at the Hotel DeSoto, Savannah, May 17-20.

R. H. MURPHY, *Secretary,*
920 Persons Bldg.,
Macon.

IDAHO STATE DENTAL ASSOCIATION

THE next annual meeting of the Idaho State Dental Association will be held June 8-10 at Lewiston.

REX W. BARSTOW, *Secretary,*
Moscow.

ILLINOIS STATE DENTAL SOCIETY

THE Illinois State Dental Society will hold its next annual meeting May 11-14 at Springfield.

L. H. JACOB, *Secretary,*
634 Jefferson Bldg.,
Peoria.

INDIANA STATE DENTAL ASSOCIATION

THE next annual meeting of the Indiana State Dental Association will be held May 18-20 at the Claypool Hotel, Indianapolis.

E. E. EWBANK, *Secretary,*
Kingman.

IOWA STATE DENTAL SOCIETY

THE next annual meeting of the Iowa State Dental Society will be held at Hotel Fort Des Moines, Des Moines, May 4-6.

C. S. FOSTER, *Secretary,*
803 Dows Bldg.,
Cedar Rapids.

KANSAS STATE DENTAL ASSOCIATION

THE next annual meeting of the Kansas State Dental Association will be held at the Allis Hotel, Wichita, April 26-29.

FRED A. RICHMOND, *Secretary,*
1008 Huron Bldg.,
Kansas City.

KENTUCKY STATE DENTAL ASSOCIATION

THE next annual meeting of the Kentucky State Dental Association will be held at the Brown Hotel, Louisville, March 30-April 3.

J. L. WALKER, *Secretary,*
640 Barbee Way South,
Louisville.

LOUISIANA STATE DENTAL SOCIETY

THE next annual meeting of the Louisiana State Dental Society will be held at the Charleston Hotel, Lake Charles, May 7-9.

JULIAN S. BERNHARD, *Secretary,*
419 Medical Arts Bldg.,
Shreveport.

MARYLAND STATE DENTAL ASSOCIATION

THE next annual meeting of the Maryland State Dental Association will be held at the Belvedere Hotel, Baltimore, May 4-5.

P. A. DEEMS, *Secretary,*
835 Park Ave.,
Baltimore.

MICHIGAN STATE DENTAL SOCIETY

THE next annual meeting of the Michigan State Dental Society will be held in Detroit, April 20-22.

WILLIAM R. DAVIS, *Secretary,*
Michigan Department of Health,
Lansing.

MISSISSIPPI DENTAL ASSOCIATION

THE next annual meeting of the Mississippi Dental Association will be held in Jackson, April 20-22.

O. L. COLEE, *Secretary,*
Magnolia.

MISSOURI STATE DENTAL ASSOCIATION

THE next annual meeting of the Missouri State Dental Association will be held at the Hotel Jefferson, St. Louis, May 24-27.

C. W. DIGGES, *Secretary,*
Exchange National Bank Bldg.,
Columbia.

MONTANA STATE DENTAL ASSOCIATION

THE next annual meeting of the Montana State Dental Association will be held in Butte, May 7-9.

T. T. RIDER, *Secretary,*
9 Higgins Block,
Missoula.

NEBRASKA STATE DENTAL ASSOCIATION

THE next annual meeting of the Nebraska State Dental Association will be held at the Cornhusker Hotel, Lincoln, May 11-13.

C. A. BUMSTEAD, *Secretary,*
Stuart Bldg.,
Lincoln.

NEW JERSEY STATE DENTAL SOCIETY

THE next annual meeting of the New Jersey State Dental Society will be held at the Ambassador Hotel, Atlantic City, May 6-8.

F. K. HEAZELTON, *Secretary,*
223 E. Hanover St.,
Trenton.

DENTAL SOCIETY OF THE STATE OF NEW YORK

THE next annual meeting of the Dental Society of the State of New York will be held at the Hotel Pennsylvania, New York, May 11-15.

CHARLES A. WILKIE, *Secretary,*
1 Hanson Place,
Brooklyn.

NORTH CAROLINA DENTAL SOCIETY

THE next annual meeting of the North Carolina Dental Society will be held at the O'Henry Hotel, Greensboro, May 11-13.

E. M. MEDLIN, *Secretary,*
Aberdeen.

NORTH DAKOTA STATE DENTAL ASSOCIATION

THE next annual meeting of the North Dakota State Dental Association will be held in Jamestown, May 11-13.

W. D. TOEPKE, *Secretary,*
New Salem.

OKLAHOMA STATE DENTAL SOCIETY

THE next annual meeting of the Oklahoma State Dental Society will be held in Tulsa, April 19-22.

EUGENE W. WISE, *Secretary,*
Medical Arts Bldg.,
Tulsa.

SOUTH CAROLINA STATE DENTAL ASSOCIATION

THE next annual meeting of the South Carolina State Dental Association will be held in Greenville, May 4-6.

P. B. HAIR, *Secretary,*
Spartanburg.

SOUTH DAKOTA STATE DENTAL SOCIETY

THE next annual meeting of the South Dakota State Dental Society will be held in Sioux Falls, May 13-15.

ERNEST W. ELMEN, *Secretary,*
Sioux Falls.

TENNESSEE STATE DENTAL ASSOCIATION

THE next annual meeting of the Tennessee State Dental Association will be held at the Hotel Patten, Chattanooga, May 11-14.

HOWARD M. TAYLOR, *Secretary,*
202 Medical Art Bldg.,
Knoxville.

TEXAS STATE DENTAL SOCIETY

THE next annual meeting of the Texas State Dental Society will be held in San Antonio, April 26-30.

WILLARD OGLE, *Secretary,*
Medical Arts Bldg.,
Dallas.

VERMONT STATE DENTAL SOCIETY

THE next annual meeting of the Vermont State Dental Society will be held in Burlington, May 20-21.

J. GILLAM IRONS, *Secretary,*
Bennington.

VIRGINIA STATE DENTAL ASSOCIATION

THE next annual meeting of the Virginia State Dental Association will be held at the John Marshall Hotel, Roanoke, April 6-8.

J. E. JOHN, *Secretary,*
Medical Arts Bldg.,
Roanoke.

WEST VIRGINIA STATE DENTAL SOCIETY

THE next annual meeting of the West Virginia State Dental Society will be held in Clarksburg, May 18-20.

C. G. ANDERSON, *Secretary,*
Mount Hope.

WYOMING STATE DENTAL ASSOCIATION

THE next annual meeting of the Wyoming State Dental Association will be held in Laramie, June 22-24.

J. D. MCNIFF, *Secretary,*
Laramie.

ALABAMA BOARD OF DENTAL EXAMINERS

THE Board of Dental Examiners of Alabama will conduct its next annual dental examination beginning June 15 at Birmingham. All credentials must be filed with the secretary at least two weeks in advance of the examination. Address all correspondence to

W. A. WOOD, *Secretary,*
Merchants National Bank Bldg.,
Mobile.

ARIZONA STATE DENTAL BOARD

THE Arizona State Dental Board will hold its annual examination of applicants for license to practice dentistry in Arizona, at Phoenix, June 29-July 2. All application blanks and fees must be in the hands of the secretary at least fifteen days prior to the date of the examination. For application blanks and other information, address

R. K. TRUEBLOOD, *Secretary,*
25 N. 2nd Ave.,
Glendale.

STATE OF CALIFORNIA BOARD OF DENTAL EXAMINERS

THE next examination to be conducted by the Board of Dental Examiners of California for license to practice dentistry or dental hygiene in the State of California will be held in San Francisco commencing May 25 at the Physicians and Surgeons College of Dentistry for theory and practical examinations and at the University of California, College of Dentistry for practical examinations. The graduates will do the practical work at their respective colleges. At Los Angeles, in the University of Southern California, College of Dentistry, examinations will be held commencing June 15. All credentials must be in the office of the secretary at least twenty days prior to the examinations. Address all communications to

KENNETH I. NESBITT, *Secretary,*
Room 203, 515 Van Ness Ave.,
San Francisco.

CONNECTICUT DENTAL COMMISSION

THE Connecticut Dental Commission will meet in Hartford, June 23-27, for the examination of applicants for license to practice dentistry and dental hygiene and to transact any other business to come before it. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks, apply to

CLARENCE G. BROOKS, *Recorder,*
302 State St.,
New London.

DELAWARE STATE BOARD OF DENTAL EXAMINERS

THE next examination of the Delaware State Board of Dental Examiners will be held June 16-19, at the Delaware Hospital, Wilmington, at 9 a.m.

CHARLES R. JEFFERIS, *Secretary,*
Medical Arts Bldg.,
Wilmington.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

THE Florida State Board of Dental Examiners will hold its annual examination of applicants for license to practice dentistry or dental hygiene, at the Seminole Hotel, Jacksonville, June 22-26. Dental candidates must file preliminary applications by April 22. Final applications of dental and dental hygiene candidates must be complete by May 2. Address all communications to

H. B. PATTISHALL, *Secretary,*
351 St. James Bldg.,
Jacksonville.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the Kentucky State Board of Dental Examiners will be held June 9-12 at the University of Louisville, Dental School, Louisville. Dentists having graduated prior to 1942 and desiring to stand examination before this board must file applications, complete with full information requested, at this office not later than March 9. Applications of 1942 graduates must be in the secretary's office by May 9. Ample time should be allowed for securing all data required. For application forms and further information, apply to

LEON M. CHILDERS, *Secretary,*
1312 First Nat'l Bank Bldg.,
Lexington, Ky.

MAINE STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the Maine State Board of Dental Examiners will be held June 22-24 at the State House, Augusta. Applications with the necessary fee must be in the hands of the secretary at least ten days prior to the date of the examination. Address all communications to

CARL W. MAXFIELD, *Secretary,*
31 Central St.,
Bangor.

MASSACHUSETTS BOARD OF DENTAL EXAMINERS

THE Massachusetts Board of Dental Examiners will hold its next annual examination June 15-18. All credentials must be filed with the secretary at least thirty days in advance. For further information, address

FRANCIS M. CAHILL, *Secretary,*
413-N State House,
Boston.

MONTANA STATE BOARD OF DENTAL EXAMINERS

A MEETING of the Montana State Board of Dental Examiners will be held in Helena on the second Monday in July 1942. All applications for examination must be in the hands of the secretary not later than twenty days previous to the opening of the examination and must be sworn to before a notary public.

D. H. MCCAULEY, *Secretary,*
Laurel.

STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY OF NEW JERSEY

THE State Board of Registration and Examination in Dentistry of New Jersey will hold its annual examinations commencing Monday, June 29 and continuing for five days thereafter. On application to the secretary, a copy of the requirements and rules for applicants, instruction sheet and preliminary application blank will be sent. Any person desiring to become a candidate must file the preliminary application, together with the examination fee of $25, on or before March 15 for the succeeding June examinations or before September 1 for the succeeding December examinations.

W. A. WILSON, *Secretary,*
150 East State St.,
Trenton.

NEW MEXICO BOARD OF DENTAL EXAMINERS

THE New Mexico State Board of Dental Examiners will hold its next examination June 15-18 at Santa Fe.

J. J. CLARKE, *Secretary,*
Artesia.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE next annual meeting of the North Carolina State Board of Dental Examiners for the examination of applicants for licensure will be held at the State Capitol, Raleigh, beginning June 22. Applications must be filed with the secretary thirty days before the examination. For application blanks and further information, address

WILBERT JACKSON, *Secretary,*
Rich Bldg.,
Clinton.

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

THE North Dakota State Board of Dental Examiners will hold its next examination in the Gardner Hotel, Fargo, June 13-16. For further information and application blank, address

L. I. GILBERT, *Secretary,*
401 Black Bldg.,
Fargo.

OHIO STATE DENTAL BOARD

THE next examination of the Ohio State Dental Board will be held at Ohio State University, College of Dentistry, Columbus, the week beginning June 22. All applications must be in the hands of the secretary at least ten days before the examination. For further information, address

EARL D. LOWRY, *Secretary,*
79 E. State St.,
Columbus.

DENTAL COUNCIL AND EXAMINING BOARD OF THE COMMONWEALTH OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will conduct examinations in Philadelphia and Pittsburgh, June 16-20. For further information and application blanks, address the Department of Public Instruction, Bureau of

Professional Licensing, Dental Division, Harrisburg.

REUBEN E. V. MILLER, *Secretary,*
61 N. 3rd St.,
Easton.

SOUTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE South Carolina State Board of Dental Examiners will hold its next annual meeting at Columbia, June 11-13.

T. C. SPARKS, *Secretary,*
1508 Washington St.,
Columbia.

TEXAS STATE BOARD OF DENTAL EXAMINERS

THE Texas State Board of Dental Examiners will hold an examination June 15-19 at Houston, at the Rice Hotel. For further information and application blanks, address

CARL C. HARDIN, JR.,
604 Littlefield Bldg.,
Austin.

VERMONT STATE BOARD OF DENTAL EXAMINERS

THE Vermont State Board of Dental Examiners will meet June 22-24 in the State House, Montpelier, to examine applicants for license to practice dentistry and dental hygiene. All applications, together with examination fee, must be in the hands of the secretary at least fifteen days before the date of the meeting. For applications and other information, address

C. I. TAGGART, *Secretary,*
139 Bank St.,
Burlington.

WEST VIRGINIA STATE BOARD DENTAL EXAMINERS

THE West Virginia State Board of Dental Examiners will hold its next examination for those desiring a license to practice dentistry or dental hygiene, at Charleston, June 29-July 2. For further information, address

R. H. DAVIS, *Secretary,*
510 Goff Bldg.,
Clarksburg.

STATE OF WISCONSIN BOARD OF DENTAL EXAMINERS

THE Wisconsin Board of Dental Examiners will hold its next examination at Marquette Dental School, Milwaukee, June 1-5. Examinations will be given for licensure of dentists and hygienists. All applications must be in by May 26. For application blanks and information, address

STEPHEN F. DONOVAN, *Secretary,*
Tomah.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS OF THE NAVY

THE next examination for appointment as assistant dental surgeon, U. S. Navy (lieutenant [junior grade], Dental Corps, U. S. Navy) will be held at the Naval Training Station, Norfolk, Va., the Naval Training Station, Great Lakes, Ill., the Naval Training Station, San Diego, Calif., and the Naval Dental School, National Naval Medical Center, Bethesda, Md., July 6. Applications for this examination should be made to the Chief of the Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

Applicants for appointment as assistant dental surgeon must be citizens of the United States, more than 21 but less than 32 years of age at the time of acceptance of appointment, and graduates of a class A dental school.

A circular of information listing physical and other requirements for appointment, subjects in which applicants are examined and other data pertaining to salary, allowances, etc., can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C., on request.

LOCATIONS FOR DENTISTS

A NEED for additional dentists exists in many of the vital defense areas. These shortages have arisen because of the great increase in civilian population that has occurred during the year. At present, needs exist in a number of states in communities varying in size from small villages to large cities. A continuing increase in population will result in overtaxing the dental personnel in many other localities where at present the dentists are very near the limit of their capacities. In many of these defense areas, there are defense housing projects in which office space or living accommodations, or both, may be secured. The United States Public Health Service in cooperation with the Division of Defense Housing of the Federal Works Agency, which supervises these projects, is interested in acquainting dentists with the needs of these communities. If you are interested in securing more specific informa-

tion about localities for the establishment of practice, communicate with

THOMAS PARRAN, *Surgeon General.*

DENTAL RESIDENCIES AND INTERNSHIPS

THOSE interested in obtaining applications for the dental residencies and dental internships at the Sea View Hospital for the fiscal year commencing July 1 can obtain information from Jerome Leon, assistant medical director of the hospital, Staten Island, New York. Dental residencies offer an annual stipend of $1,200 and complete maintenance. Dental internships offer $15 monthly and complete maintenance. Sea View Hospital is the largest tuberculosis hospital in the world and offers exceptional facilities in the various phases of dentistry.

RALPH HOWARD BRODSKY, *Director*
Division of Oral Surgery,
Sea View Hospital.

DENTAL RESIDENCY

THE University of Oregon Medical School Hospitals and Clinics offers a residency in dental medicine and oral surgery, the period of service to be one year, with compensation $40 monthly, in addition to board, room and laundry. The division is under the general direction of the department of medicine and the direct supervision of the head of the division and a visiting staff of sixteen dentists. Service is carried on in the outpatient clinic and the three hospitals. Application blanks will be furnished on request. Direct inquiries to

RICHARD B. DILLEHUNT, *Dean,*
University of Oregon Medical School,
Portland.

DENTAL RESIDENTSHIP

A TWELVE months' dental residentship is available at the Western Pennsylvania Hospital, Pittsburgh, beginning July 1. The applicant for this position must be a graduate dentist holding a Pennsylvania license and having had the minimum of one year's dental internship in a recognized hospital. A salary of $83.33 per month with maintenance is offered with the position.

J. A. GARDNER, *Chief,*
Dental Department.

RESEARCH FELLOWSHIP IN MEDICINE AND DENTISTRY AT THE UNIVERSITY OF ILLINOIS

THE Graduate School of the University of Illinois has established four research fellowships to be awarded for one year in the fields of medicine and dentistry in Chicago at a stipend of $1,200 per year (calendar year with one month's vacation). Candidates for these fellowships must have completed a training of not less than eight years beyond high school graduation. This training may have been acquired in any one of the following ways, or the equivalent thereof: 1. Work leading to the B.S. and M.D. degrees. 2. Work leading to the B.S., M.S., and D.D.S. degrees. 3. Work leading to the B.S. and B.A. degrees in a four-year collegiate course and to the D.D.S. degree. 4. Work leading to the B.S., D.D.S. and M.D. degrees. The fellowship year begins September 1. Formal application blanks can be secured from the Secretary of the Committee on Graduate Work in Medicine and Dentistry, 1853 W. Polk St., Chicago, Ill.

BRONX HOSPITAL VOLUNTEERSHIPS

THE Dental Department of the Bronx Hospital offers a number of volunteerships to recent graduates in dentistry in the following branches: oral surgery and anesthesia; surgical pyorrhea; orthodontia; root canal therapy, and operative dentistry. Those offering satisfactory credentials indicating their interest in the clinical study of dental surgery as a health problem will receive consideration. Address applications to the Dental Department, Bronx Hospital, Fulton Ave. at 169th St., Bronx, New York. Appointments will begin in July.

DAVID WURZEL, *Director,*
Dental Department.

BRONX HOSPITAL DENTAL INTERNSHIP

EXAMINATION for a dental internship for one year beginning July 1 will be held April 3 at 10 a.m. at the Bronx Hospital, Fulton Avenue at 169th St., Bronx, N. Y. The Bronx Hospital is a modern institution with a capacity of 329 beds for acute diseases. It has a very active outpatient department in dentistry, including periodontia, orthodontia, oral surgery, root canal therapy and opera-

tive dentistry. Write for application form to the superintendent of the hospital.

INTERNSHIP APPOINTMENTS

THE Walter G. Zoller Memorial Dental Clinic, University of Chicago, offers four rotating internship appointments, effective July 1, 1942, to June 30, 1943. The clinic maintains four divisions of service: 1. The Zoller Clinic in Billings Hospital for general dental service. 2. The University Dental Clinic in Billings Hospital for diagnosis and minor oral surgery. 3. The Prenatal Dental Clinic in Chicago Lying-In Hospital for general service. 4. The Orthopedic Dental Clinic in the Home for Destitute Crippled Children for general dentistry. In addition to clinical practice, the intern will assist in the department of anesthesia and have the privilege of attending all departmental seminars on dentistry, medicine, pathology, etc. Those seniors interested should write immediately for application blanks to the Director, Walter G. Zoller Memorial Dental Clinic, University of Chicago, Chicago.

CARNEGIE FELLOWSHIPS FOR RESEARCH AND GRADUATE WORK IN THE DENTAL SCIENCES

AIDED by the Carnegie Corporation, the School of Medicine and Dentistry of the University of Rochester offers scholarships paying $1,200-$1,800 per annum to well-trained dental graduates who are interested in research or who desire special training in the basic medical sciences as an aid to dental teaching or practice. A few fellowships also offer part-time training in oral surgery. On appointment, the applicant is given the title of Carnegie Dental Fellow and, according to his interest, works as a graduate student in one of the departments of the medical schools. Here, excellent laboratory facilities, adequate direction and close contact with various investigations related to medicine and dentistry help his research and study. Fellows are encouraged to attend medical classes, seminars and staff meetings and, when opportunity presents itself, to participate in class instruction and scientific meetings. Contact with the problems of clinical dentistry may be maintained through the Oral Surgery Clinic of the Strong Memorial Hospital and the Rochester Dental Dispensary. With the approval of the Graduate Council of the university, Fellows may prepare themselves for the degree of M.S. or Ph.D. Applications should be made to

GEORGE H. WHIPPLE, *Dean*,
School of Medicine and Dentistry,
Rochester, N. Y.

NEW YORK UNIVERSITY COLLEGE OF DENTISTRY POSTGRADUATE COURSE

THE New York University College of Dentistry announces a postgraduate course in inhalation anesthesia with special emphasis on nitrous oxide-oxygen anesthesia, conducted by E. A. Rovenstine, professor of anesthesia, New York University College of Medicine and Bellevue Hospital, and A. S. Mecca, assistant professor of oral surgery, New York University College of Dentistry and Bellevue Hospital. The course will be given Friday mornings for six consecutive weeks beginning April 24 and ending May 30. Classes will begin at 9 a.m. and continue to 12 noon. Direct all communications to the office of the dean, New York University College of Dentistry, 209 E. 23d St., New York, N. Y.

POSTGRADUATE COURSE IN PERIODONTIA

THE New York University College of Dentistry will hold its ninth annual postgraduate course in periodontia for twenty sessions, as follows: Schedule A, morning and afternoon sessions, June 15-26. Schedule B, morning and afternoon sessions, June 15-17; mornings only, June 18-July 8. Fee $100. Course limited to fifteen men. Preference given in order of receipt of application. The course will include etiology, diagnosis and treatment of periodontal disease; various technics of pocket eradication, with conservative treatment stressed; Vincent's infection; diagnosis of types of bone resorption; mouth manifestations of systemic disease; periodontal foci of infection; toothbrushing; instrumentation, diet; balancing of occlusion; taught by lectures and clinical work, each student treating several cases. Instruction by Samuel Charles Miller, Sidney Sorrin, J. Lewis Blass and the entire periodontia faculty. For further information and application, address the Office of the Dean, New York University College of Dentistry, 209 E. 23rd St., New York, N. Y.

POSTGRADUATE COURSES, COLLEGE OF DENTISTRY, OHIO STATE UNIVERSITY

THE College of Dentistry of Ohio State University, Columbus, offers postgraduate courses in dentistry that are especially designed for the general practitioner who may wish to amplify his training in any of the following fields: x-ray technic and diagnosis (course offered June 8-12); crown and bridge work (June 15-20); oral surgery (June 15-19); prosthodontia (June 15-20); operative dentistry (June 15-19), and root canal therapy (June 15-19). Periodontia will be offered one day per week for ten consecutive weeks beginning June 17. The fee for these courses is $50. A postgraduate course in orthodontics is offered on a part-time basis. The fee and length of course is determined by the scope of the student's fundamental undergraduate training in this subject. Registration in all courses is limited to ten men. It is the aim of these courses to teach new technics as well as to review fundamentals. For further information and application blanks, address the Dean, College of Dentistry, Ohio State University, Columbus, Ohio.

COLUMBIA UNIVERSITY SCHOOL OF DENTAL AND ORAL SURGERY REFRESHER COURSES

COLUMBIA University School of Dental and Oral Surgery offers two short courses in periodontia for qualified graduates in dentistry January 23 to May 22, 1942, and September 18, 1942, to January 15, 1943.

A ten-day intensive course will include lectures, discussions, demonstrations and clinical practice. An extended course, one half day per week for two sessions, will include lectures, discussions and supervised technical treatment. Both courses will be conducted by Frank E. Beube, Isador Hirschfeld, Harold J. Leonard (executive officer) and Arthur H. Merritt.

The courses given at the School of Dental and Oral Surgery, Columbia University, are designed to be "refresher" courses; i.e., to bring practitioners abreast of modern undergraduate teaching in theory and practice in the subject. Admission to the course is limited to qualified graduates in dentistry who are members in good standing of the American Dental Association or recognized sectional organizations. In the case of foreign applicants, membership in the applicants' national dental organization is required.

Information can be obtained from the registrar, School of Dental and Oral Surgery, 630 West 168th Street, New York, N. Y.

POSTGRADUATE COURSE IN PRACTICAL ORAL PATHOLOGY, SCHOOL OF DENTAL AND ORAL SURGERY, COLUMBIA UNIVERSITY

THE School of Dental and Oral Surgery, Columbia University, offers a short course in oral pathology and its practical application for qualified graduates in dentistry under the direction of Lester R. Cahn, April 1, 8, 15, 22 and 29. Admission to the course is limited to members of the American Dental Association. For further information, address the assistant to the registrar, School of Dental and Oral Surgery, Columbia University, 630 West 168th St., New York, N. Y.

UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED DURING DECEMBER 1941, AND JANUARY AND FEBRUARY 1942

December 2

No. 2,264,313, ARTHUR A. HUMPHREY. Article of manufacture.

No. 2,265,102, EDWARD P. CRESSLER and HELEN M. HAYNE. Toothbrush.

No. 2,265,118, WALTER J. VAN ROSSEM. Hydrocolloid molding composition and material for use therein.

December 9

No. 2,265,391, SIMON MYERSON. Artificial tooth.

No. 2,265,420, ARCHIE B. BRUSSE and FRANCIS M. GODDARD. Orthodontic appliance.

December 16

No. 2,266,195, ROBERT LAY HALLOCK. Toothbrush.

No. 2,266,285, ISIDORE STERN. Removable dental bridge attachment.
No. 2,266,434, MAX MORRISON. Dental model.
No. 2,266,478, HARRY SNELL. Dental plate.
No. D-130,781, EDWARD L. CHOTT. Design for a dental tool.

December 23

No. 2,266,860, WALTER H. GRIESINGER. Orthodontic appliance.
No. 2,266,998, ARTHUR E. SMITH. Side loading syringe.
No. 2,267,009, ALBERT W. ADOLPHSEN and CHARLES WETTY. Oxygen inhaling assembly.
No. 2,267,073, CHARLES EDWARD BOYD. Orthodontic appliance.
No. 2,267,074, WILLARD H. BROCKWAY. Cartridge for hypodermic syringes.
No. 2,267,141, ALFRED SIMON. X-ray circuit for eliminating grid shadows.
No. 2,267,625, SAMUEL WULFSON. Container for tooth paste.
No. 2,267,653, EVERETT HAWKINS. Extension light stand.
No. 2,267,670, IRVING ROSENWASSER. Toothbrush.

December 30

No. 2,267,836, ERNEST V. PARKIN. Matrix and holder therefor.
No. 2,267,908, EDWIN R. GOLDFIELD. X-ray timer safety attachment.

January 6

No. 2,268,915, HELENE WASTI and REINHARDT BEUTNER. Method and material for detoxifying local anesthetics.
No. 2,268,928, HAROLD PALMER DUEY. Fountain toothbrush.
No. 2,268,994, ARTHUR E. SMITH. Syringe ampoule.
No. 2,269,061, HERMAN RICHARD NERBAS. Dental articulator.
No. D-130,993, WILLIAM G. LEWIS. Design for a dental forceps.

January 13

No. 2,269,513, JAMES ALBERT BORN and RICHARD CARLE DUNKER. Toothbrush.
No. 2,269,585, MAX G. FELDMAN and BENJAMIN PERLOW. Artificial tooth.
No. 2,269,698, EARL C. STANGEL. Dental tool.
No. 2,269,780, MARTIN MYERSON. Card for artificial teeth.
No. 2,269,820, JAMES A. JONES and EDWIN M. NASH. Holder for dental film developing hanger.

January 20

No. 2,270,523, JAY A. HEIDBRINK. Gas control means for anesthetizing machine.
No. 2,270,561, WILLIAM E. SANBORN. Method of and apparatus for making dentures.
No. 2,270,629, SIDNEY C. FOURNET. Method and apparatus for making dental restorations.
No. 2,270,836, SAMUEL LIONEL JEFFERIES. Water cooled impression tray.

January 27

No. 2,271,264, ERICH KAUFMANN and WILHELM TRUTHE. Process for the conversion of metals and metal alloys in finely divided form for the manufacture of dental amalgams.
No. 2,271,454, REINER W. ERDLE, HENRY SOLLER and PAUL H. BEIER. Method of forming a reproduction of an article.

February 3

No. 2,271,546, LOGAN EISELE. Hypodermic syringe.
No. 2,271,720, ARTHUR E. SMITH. Syringe.
No. 2,271,796, PAULINE S. ECKMAN. Adjustable attachment for bridgework.
No. 2,271,934, ROBERT H. BROCKMAN. Mandrel.

February 10

No. 2,272,723, STANLEY E. NOYES. Dental impression material.

February 17

No. 2,273,207, JOHN W. KUHN. Toothbrush.

February 24

No. 2,274,042, ERIC LEOPOLD HUGO COSBY. Tooth and like brushes.
No. 2,274,186, CHARLES HAROLD BRACE. Method of and apparatus for investing patterns under vacuum.

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